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PAPERS READ BY TITLE

DUST AND THE SPRAY GUN IN CALYX WORM CONTROL[1]

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Ever since the late Dr. A. J. Cook carried on some calyx worm control experiments in Michigan a half century ago entomologists have argued one way or another relative to the way and in the amounts this poison becomes established in the calyx cups. The correct type of nozzle and the type of spray necessary to accomplish best results has been a much mooted question. In this connection some of our more enthusiastic colleagues have even gone so far as to believe that one well timed calyx application would be sufficient to handle the codling moth under ordinary seasons of infestation.

Observations made by investigators in different parts of the country during recent years have pointed out that the percentage of calyx entrants is a very variable factor during different seasons in different sections. It has been the writer's observation that during some seasons a very high percentage of the worms enter through the calyx and during others the reverse would be true. During the past season the worms entered in about equal proportions through the calyx and side on Spitzenbergs, while in Newtowns, side entrants occurred in a

[1] The manuscript was received too late for insertion at the proper place in the Proceedings.—ED.

much larger proportion. From information that I have received from various sources a condition of this sort was quite general throughout the northwest during the past year.

It is not my purpose to in any way depreciate the importance of the calyx application in the minds of the orchardists. The more stress that we can lay upon this and the cover sprays the better will be the results. However, over emphasis of the calyx application has been harmful in that it has had a tendency to depreciate (in the minds of the growers) the value of cover sprays and much worminess has been the result.

The writer has been keeping in very close touch with codling moth activities in Hood River for six years. During the past four years experimental work with dust and sprays of various sorts has been under observation.

The dusting method of applying arsenate of lead and sulphur to apples for the control of various insects and plant diseases created much interest following the publication of the work of Reddick and Crosby[1] in 1914 and 1915. The results of their work indicated that apple insects and diseases of importance in the East, other than San José scale and the various apple aphids could be controlled in about the same degree as with the liquid. In the West we have to add to this list of uncontrollable troubles, powdery mildew, anthracnose, and the leaf roller as well as a few minor insect pests. This fact places a very decided limit upon the general utility of the method and makes it a means of general control that we can not recommend.

The results of Reddick and Crosby are especially interesting to me as I have been able to duplicate their results with scab and codling moth control during the four years of the investigation. To the entomologist working on codling moth control these results should be decidedly significant. Reddick and Crosby do not go into the critical analysis of the proportions of calyx and side worms yet their good results indicate that they accomplish calyx worm control. How can the advocate of the so-called driving calyx spray explain this control? The writer's work shows that this control is very decidedly accomplished. The dust cannot be driven. Quiet air—atmosphere—is the carrying medium used in placing the dust particles on the surfaces which require protection. A wonderful coating can be given a tree even to its uppermost branches. Upper and under surfaces of the leaves as well as the fruit alike are covered. This air conveyor being in motion, a slight breeze, very light indeed, upsets the plans of procedure. A breeze makes it almost impossible to hit the tops and even if this were accomplished the particles are moved past the surfaces so

[1] Bulletins: 354 and 369 Ag. Exp. Sta., Cornell University.

fast that only a very small percentage sticks. The remainder passes on and is wasted for the most part. When the air is quiet these particles will hover for a long time over a tree and gradually settle. Air currents destroy the plan of the system and applications made under such conditions can only result in disaster.

In order to avoid windy conditions it was found necessary to dust very early in the mornings; a calm usually occurs in most sections of the valley during this period of the day. However with us during the spring months it is not uncommon for a wind of varying degree to occur continuously for several days at a time. Many times in the carrying out of the experimental work the dusting had to be postponed for more favorable weather. We are all familiar with the fact that successful applications of spray cannot be delayed to any great extent and at the same time accomplish results. Several of our growers have used the dusting method; for the most part their work has been done regardless of air movement. In 1918 the condition of the fruit in one of these orchards was checked up; a 33 per cent injury from the codling moth was found. None of the growers of the valley have depended upon the system during the past year. On account of the many handicaps and difficulties encountered I do not recommend the method to our growers except those located on steep hillsides and in sections where sufficient water for spraying is difficult to obtain.

The results, however, that have been obtained in calyx worm control have a very decided bearing on the results that can be expected with the spray gun when properly used. For this reason I will discuss some of the results that have been obtained in seasons past with both dust and liquid applications. These results are summarized on the accompanying chart. In 1917 the unsprayed check trees in an orchard which had been quite wormy for several seasons, developed an infestation of 65.13 per cent. Of this infestation 31.68 per cent were side worms and 68.32 per cent were calyx worms. (Exp. 5 in table.) The variety used in this set of experiments was Arkansas Black. This ratio did not hold true in all varieties. In an orchard of Spitzenbergs this ratio was 66.96 per cent side worms and 33.04 per cent calyx worms. In a Newtown block this ratio was 61.54 per cent to 38.48 per cent side and calyx worms respectively. In the block of Arkansas Blacks, two dust experiments were checked against two blocks of trees sprayed with twelve foot rods. In Experiments 1 and 3 an early September application was omitted resulting in a much more wormy condition than occurred in Experiments 2 and 4 (see table). These different experiments are cited to show, that regardless of this marked difference in worminess, the general relation of side and calyx worms remains fairly constant, though with the increase in total worminess the chances

of calyx entrants also increases. The very marked difference between the figures obtained on the check trees as compared to both dusted and sprayed indicate the influences that are brought to bear in calyx worm control. Experiment 2 (dust) gave the best calyx worm control during 1917 where the ratio was found to be 92.99 to 7.01, side and calyx worms respectively. Experiment 4 (rods) followed with a 80 to 20 ratio. The gun was not tested in this orchard in 1917. These blocks as has been stated were sprayed extra in September. The rods in the heavier infestation gave slightly better calyx control, 73.55 per cent being side entrants as compared to 71.6 per cent in the dust block.

Dusting work was not continued in the Arkansas Black orchard in 1918 but was continued in a block of Newtowns in a different orchard. As will be noted in Experiment 6 the check block for this series of experiments developed a 17.64 per cent infestation. During this season throughout the district a greater percentage of side worms entered than calyx worms. The unsprayed (Exp. 8) checks developed 73.29 per cent side worms as compared to but 26.7 per cent calyx worms. However, regardless of this rather small percentage of calyx worms the difference of amount in calyx worm control is again pointed out in the results obtained. During this season calyx entrants were cut down to 5.2 per cent in the dust block. These results were checked against a block sprayed with a gun in the same orchard which developed but .44 per cent wormy fruit (Exp. 7), and perfect control as far as calyx worm control is concerned. This work was continued in these same blocks in 1919, and though not presented on the chart gave the following results. The check trees developed 80. per cent side and 20 per cent calyx infestation. The figures in the dust block are 96.77 per cent side worms and 3.22 per cent calyx worms. Unfortunately the gun block upheld the 1918 performance and developed not a single calyx worm in the apples counted. The figures look too good but nevertheless these are the ones obtained. At this point I might add that this orchard, outside of the experimental work that has been conducted with dust, has been sprayed with a gun only since 1917.

Before being too firmly convinced of the relative merits of calyx worm control with dust and with spray gun a series of experiments were arranged in 1919 to compare the merits of the gun and rod in an orchard which had been quite wormy for several years. The orchard which was chosen for this work suffered a loss of 20 to 30 per cent damage in 1918. In 1917 the loss was even greater. In the spring of 1919 many worms were found on the trunks of trees so there was no doubt but that there would be plenty of insects with which to work. Three blocks were chosen through the center of the orchard. One was

Table I—Relation of Side to Calyx Worms
Hood River, Oregon, 1917, 1918 and 1919

Exp. no.	How applied	Total per cent worms	Per cent side worms	Per cent calyx worms	Relation of side to calyx worms in per cent
1917					
1	Last spray omitted	12.96	9.28	3.68	71.6 to 28.4
2	Dust	5.37	5.00	.37	92.99 to 7.01
3	Last spray omitted	14.33	10.54	3.79	73.55 to 26.44
4	Rods	1.43	1.14	.28	80.00 to 20.00
5	Check	65.13	20.62	44.51	31.68 to 68.32
1918					
6	Dust	2.68	2.54	.14	94.7 to 5.2
7	Gun	.44	.44	.0	100.00 to .00
8	Check	17.64	12.9	4.7	73.29 to 26.7
1919					
9	Rods in calyx, guns in other sprays	2.39	2.05	.34	85.74 to 14.28
10	Gun all sprays	2.27	1.91	.35	84.24 to 15.71
11	Rods all sprays	3.41	3.12	.29	91.64 to 8.54
12	Guns, fruit from 1 to 12 ft. high	1.08	.99	.09	90.9 to 9.0
13	Guns, fruit from 12 ft. to tree top	5.1	4.2	.9	81.13 to 18.86
14	Check	53.6	24.2	29.4	45.16 to 54.83

Note—1917; Five standard sprays applied unless otherwise stated.
1918; Four standard sprays applied.
1919; Five standard sprays applied.
In Exp. 12, fruit separated from ground to 12 feet. Exp. 13, from 12 feet to top of trees.

sprayed with the gun throughout the season (Exp. 10). Another was sprayed with twelve foot rods throughout the season (Exp. 11). Experiment 9 gives the results obtained with the use of rods in the calyx application, guns being used for the other sprays. The varieties used in the test were Jonathans, Newtowns, and Spitzenbergs. The tree were fifteen years of age. This discussion, presented in the accompanying table, with the exception given, includes the results obtained in the Spitzenberg block only. The spray was applied by the owner and his hired man under the supervision of the writer who followed behind the men while the trees were being sprayed in each application. Two guns were used on a 3½ power outfit of a well-known make. The work was well done and well timed throughout the season. Five applications of arsenate of lead were used during the year; the last one, as the season finally turned out, was not very important. A summary of the results not only shows that the gun held its own in obtaining codling moth control but gave better control than the rods and also where the rods were substituted in the calyx application that the calyx cups

might be filled. The check trees (Exp. 14) developed an infestation of 53.6 per cent; the ratio of side to calyx worms was 45.16 per cent to 54.83 per cent. In Experiments 9 and 10 (rods in the calyx and guns in all applications) the percentage of calyx entrants was found to be practically the same, .34 and .35 per cent. The ratio of side to calyx worms being 85.74 to 14.28 per cent for the rods and 84.24 to 15.71 per cent for the guns. It is interesting to note here that the field control obtained by the owner two rows away from the check trees ran .56 per cent wormy, fruit being checked up at random at harvest time. This demonstrates what can be done in a badly infested orchard in a season with a spray gun.

Another point upon which there is no experimental information available is the matter of worm control in the tops of large trees with the guns. At picking time the fruit was segregated in the different experiments in lots from the ground to 12 feet and from 12 feet to the tops of the trees (Exps. 12 and 13). The trees in question were quite tall, considerable fruit occurring from 20 to 25 feet from the ground. Up to a height of 20 feet effective control can be obtained; above this point, however, effectiveness rapidly decreases. For example, in one tall tree 123 apples (which are included in the results given in Exp. 13) were picked at a height of 25 to 28 feet; 22 of them were found to be wormy. No fruit occurred at the greater heights in the blocks sprayed with the rods so that comparative figures are not available. The results would seem to indicate that very good calyx and side worm control can be expected up to a height of 25 feet, above which point very poor protection is accomplished.

From figures which I have been accumulating it appears that the codling moth is inclined to deposit more eggs in the tops of the trees than nearer the ground. It is quite important then that the fruit should either not be grown at that height or should be very well sprayed in order to reduce worm infestation to the minimum. This could be accomplished by spraying from a tower.

The poor results that have been obtained with the spray gun are not due to the principal involved in applying the spray. Unsatisfactory control can be the result of the misuse of one of three—or perhaps better—the combination of three misused factors. These are poor equipment, poor work and irregularity of application. Of the three factors, the first mentioned is probably the most important from the standpoint of the use of the gun. The other two factors are contingent upon the first. The spray gun is a useless accessory on a poor spray outfit. It is little better than nothing and will never give good results. Our up-to-date 3½ horse power sprayers are indeed too small to handle two guns effectively, they will handle one in good shape. A machine

of this power, in order to throw a spray of the proper quality must maintain a pressure of at least 275 pounds. In the experimental work just referred to a machine of this character was used. In order to keep the spray in proper form it was tuned up and punished throughout the season. When one begins to punish a gas engine and pumps trouble, then the owner of this machine has his share. This condition of affairs existed in many orchards throughout the valley and was typical of no particular make of sprayer. A spray machine, in order to live the life that it should and at the same time deliver the goods must have a liberal reserve. A machine of 10 horse power is none too much. Such spray machines are now coming into use and it will be only a question of a very few years until all of the present so-called modern sprayers will go into the discard. The results given in Experiment 7 were obtained with one of these larger types of sprayers. The control presented here is undoubtedly better than would be accomplished by the average orchardist—it is at least significant.

The gun where operated with small inferior equipment has given a very poor account of itself. I have carefully checked up the results obtained in several orchards where poor equipment has been used. The growers tried to do good work and timed their application well. Breakdowns and low pressure, which is usually the rule when a machine is not working right have lead to very poor results. The lower fruits as a rule came through the season in fairly good shape. In 1918 in one of these orchards under observation the following records were made. Apples growing below 12 feet developed a worm infestation of 3.55 per cent. Apples growing between 12 feet and the tops of the trees developed an infestation of 17.63 per cent. There is only one explanation for this condition and that is the fact that the spray was not applied properly to the tops of the trees.

Low pressure from these small capacity outfits does not produce a spray of the proper consistency to accomplish a satisfactory coating. The liquid leaves the gun in a coarse, splattering stream. There is no fineness of division of the particles and the only way that a tree can possibly be covered is to drench and thereby waste much material. As I have said before it is my belief that finely divided spray which has much the same consistency of the dust particles—which controls calyx worms operates in the case of properly applied liquid solutions. If this spray is not broken up into a light drifting mist the principal of calyx worm control is destroyed and poor results are bound to follow. There is no possible chance of obtaining much calyx protection in tops of trees with a gun throwing a coarse splattering spray. This might possibly be accomplished from a tower. Gravity is the factor which allows the poison to reach the calyx ends of the uppermost apples. The

spray material must be placed there in the proper condition and in sufficient amounts to effect a coating as it falls. A coarse spray goes up in large droplets and comes down in much the same form. Unless a very excessive amount of spray material is thrown into the top of the trees only a few of the calyx ends will receive much spray and these will be decidedly spotted.

In summarizing then, the successful use of the spray gun depends almost entirely upon the manner in which the spray is broken up. A pressure of 250 pounds on the large sprayers, *i. e.*, the 10 horse power machines delivers a beautiful spray from two guns. This amount of pressure on a small outfit does not produce the same sort of spray. It takes at least 300 pounds with a 3½ horse power outfit to approach this spray and then it is nowhere nearly as good. I am not sufficiently versed in mechanics to explain just why this difference occurs. Nevertheless there is a difference and anyone who will handle the delivery from the small and large outfits can immediately feel the difference in the "life" of the spray. I am not conducting a propaganda for any one large type of sprayer, unfortunately at the present time there is only one on the market. Our other sprayer manufacturing companies must bring up their standards if they are to meet the demands of the orchardists for there will be a very great demand for these during the next few years. With the coming of increased facilities for proper spraying I firmly believe that we will see a marked improvement in our codling moth control and a yearly saving which will amount to many thousands of dollars.

Summary

The percentage of calyx entrants in apples is a very variable factor. In some seasons larger percentages enter than in others. There is much variation in different varieties of apples.

The percentage of calyx entrants is not as great in the Northwest as one would be led to believe in reviewing the literature on the subject.

Dust controls calyx worms. It can in no sense of the word be called a "driving application." The material settles upon the locations needing protection and accomplishes results if properly applied; this including calyx protection.

Spray applied in finely broken up particles operates in exactly the same way whether applied with a rod or spray gun.

The spray gun, in order to produce the proper type of spray cannot be used on inferior equipment. Two hundred and seventy-five pounds pressure with a 3½ horse power sprayer produces a fair spray with two guns—an excellent spray with one gun. There is a very great need for higher powered sprayers with a liberal reserve. To be entirely effective the gun must be backed up with such equipment.

OBSERVATIONS ON THE EFFECT OF STORM PHENOMENA ON INSECT ACTIVITY[1]

By D. C. Parman, *United States Bureau of Entomology*

The discussion will deal primarily with the effect of barometric pressure on insect life as other storm phenomena—wind, rainfall, temperature, atmospheric moisture, etc.,—have been more fully studied and discussed in general literature and time and space will not allow more than brief reference to these to make the matter clear. No experimental data have been gathered, all observations being made in natural surroundings and in cages used in other experimental work. Most of the observations have been made on Muscids and related diptera, only general notes being made on other insects in the field and at lights.

Until the fall of 1916 no barometer was available at the Uvalde, Texas, laboratory where the observations recorded herein were made. This permitted only of studies of the daily map of the Weather Bureau in connection with records made on insect activities. In the fall of 1916 a compensating aneroid barometer was obtained and since that time regular readings have been made at 8:00 a. m. and 8:00 p. m. with special readings at time of storms.

The first observation made on a storm of any severity was on the West Indian hurricane which passed over southwest Texas on the night of August 18, 1916. Some of the more significant data relating to this storm will be given from an extract of the "Monthly Weather Review" of August, 1916, and this publication should be consulted for fuller details. "The tropical cyclone passed inland between Corpus Christi and Brownsville the afternoon and evening of the 18th. After passing inland a short distance south of Corpus Christi the cyclone continued to move in a west-northwest direction, reaching Del Rio, Texas, at about 7:30 a. m. local mean time August 19, with a minimum pressure of 28.69 inches. Since it passed Corpus Christi, 200 miles distant, 12 hours earlier, we may assign a movement of about 17 miles per hour. The recovery of the pressure after the passage of the center of the storm was extremely rapid. . . . We must consider that it dissipated over southwest Texas during the daylight hours of the 19th. . . . It is worthy of note that all of the tropical cyclones of August, 1916, were characterized by remarkably small diameters and naturally extremely steep barometric gradients near the center only. . . . And the fact that the centers did not closely approach any of the network of land stations except for a very brief period, the location of the center of the storms in each case was a very unsatisfactory matter . . . (Corpus Christi). The barometer reached its lowest point,

[1] Published with the permission of the Chief of the Bureau of Entomology.

29.05–29.07 inches reduced to sea level at 6:15 p. m. . . . The wind . . . estimated maximum velocity of 90 miles. . . . There can be no question that the storm was a fully developed hurricane with a central pressure at least one inch lower than observed at Corpus Christi."

The following table gives data at different stations.

Date	Place	Minimum pressure[1]		Maximum wind velocity		Rainfall
1916		Hour	Inches	Hour	Miles per hour	Inches
Aug. 18	Corpus Christi	6:15 p. m.	29.07	6:50 p. m.	90	1.58
18	Brownsville	7:00 p. m.	29.50[2]	8:30 p. m.	60[3]	
19	San Antonio	1:00 a. m.	29.63	2:31 a. m.	56	
19	Del Rio		28.69		60	

[1] Reduced to sea level.
[2] Lowest reading on record for month.
[3] 5 min. period.

Judging from the storm damage it must have had its center in the vicinity of Uvalde, Texas, the damage being less both north and south. The rainfall at Uvalde was 3.1 inches and the wind was probably about 75 miles per hour. Not a single windmill was left standing, many small buildings were wrecked and doors and windows were blown from the most substantial houses in the immediate vicinity of Uvalde, the path being in a southeast to northwest direction.

August 18, 1916 was a pleasant summer day about three degrees cooler than the several preceding days, a maximum of 90 and a minimum of 71. The wind was blowing a light breeze from the northeast instead of the usual southeast breeze at this time of the year. No barometer was at hand and no warning of the storm was had except the clustering of the flies. Nothing unusual was noted until about 8:00 p. m., the wind changed to the northwest and became stronger until it was blowing a gale at 2:00 a. m. From 2:00 a. m. to 3:00 a. m. it was changeable and gusty. Probably a little before 3:00 a. m. straight winds from the southeast began to blow and buildings and trees began to fall.

Previous to the storm, only a few days, *Stomoxys calcitrans* were very abundant and annoying the stock much in the farming districts east of town. After the storm stockmen and farmers made the assertions that the flies were very bad the day before the storm but they had seen very few since. Examinations of certain stock were made eleven days before the storm and they were almost covered with stable flies, while after the storm no individual animal had more than five or six

flies upon it. At the laboratory, where from one to more than five thousand *Musca domestica* and *Chrysomyia macellaria* were taken in periods of 48 hours in traps before the storm only 8 to 31 were taken after the storm during the remainder of the season (trappings were made semi-monthly on 1st and 15th). About 5:00 p. m., August 18, attention was drawn to large numbers of house flies on the screens about the house; many of the screens being literally covered and they were found to be collecting in protected places. A bucket of kitchen refuse was examined where only a few hours before hundreds of *C. macellaria* and *M. domestica* were feeding and only a few specimens of *C. macellaria* were found deep in the bucket and no *M. domestica* were present. After the storm it was rare to see more than two or three specimens of either species for a period of ten to fifteen days. All species of diptera diminished appreciably with the storm, but of the ones under observation Lucilia sp. was least affected.

During the last three years observations have been made on several species of Muscids showing that with a rapidly falling barometer they first become nervously active and then go into a state of partial coma. Some species have a tendency to seek a place of protection at this time, others show this tendency very little but become quiet at a most convenient place. While the flies are in this state of coma they are more subject to action of other destructive agencies, probably diseases included. Heavy rains are destructive to insect life to some extent, as has been observed by other writers and workers. The chilling effect during the storm might have contributed to some extent to the destruction of the flies as the minimum for August 19 was 67 degrees. Mechanical action of the wind and action of sea spray possibly contributed to the destruction, but it is evident that the destruction of flies during this storm was rather unusual and the unusual characteristic of the storm was the very steep and short barometric gradient.

Another tropical storm visited this section September 14 and 15, 1919. This storm was very similar to the storm of August 18, 1916, except the barometric gradient was not so steep and the wind was not quite as strong but lasted longer. The barometer began to fall on the evening of September 13 from 29.05. It was 28.85 on the morning of the 14th and 28.65 in the evening, 10:00 p. m. 28.60, 11:00 p. m. 28.55, September 15 at 1:30 a. m. 28.45, 2 a. m. 28.50, 3:30 a. m. 28.40, 4:00 a. m. 28.50, 5:00 a. m. 28.45, 6:00 a. m. 28.50, 8:00 a. m. 28.50, noon 28.70, 8:00 p. m. 28.90. The rainfall was 3.75 inches. The wind was blowing a strong breeze from the northeast on the morning of the 14th and increased to a high wind by 10:00 p. m. and to the proportions of a storm by 2 a. m. September 15, at which time it became changeable to the southeast and blew from 50 to 60 miles an hour until

about 4:00 a. m. and probably was blowing 40 miles at 6:00 a. m., and a strong wind was blowing at 2:00 p. m. and a moderate breeze at 8:00 p. m. The maximum temperature of the 13th was 91, the minimum 70; 14th, 80 maximum, 72 minimum; 15th, 80 maximum and 67 minimum.

The decrease in the number of flies was quite appreciable after this storm; the abundance of flies before the storm was about the same as before the storm of 1916 except *Haematobia irritans* which was very numerous prior to the late storm and was not abundant before the storm of 1916. This fly was practically exterminated during the recent storm, adult *C. macellaria* decreased about 75 per cent, *M. domestica* decreased about 50 per cent and *Stomoxys calcitrans* about 25 per cent. Adults of all species under observation were decreased to some extent. After the storm of 1916 there was never any appreciable increase in the number of adult flies, although weather conditions were apparently very favorable for increase. After the recent storm the increase in all species was rapid. This increase became noticeable about 15 days after the storm, this being approximately the duration of the immature stages of the species concerned. It is quite probable that many of the immature stages as well as the adult flies were killed during the storms. This is caused by the washing and drowning of the larvæ, as was noted in the last storm and may possibly be augmented by sea spray. It has been determined in preliminary experiments that a solution of sodium chloride as weak as .25 per cent is detrimental to breeding of some species of Diptera in certain cases. This destruction of larvæ and pupæ, together with the almost complete destruction of adults during the first storm, left a very few flies to breed and this together with the variable barometric pressures and storms never allowed an increase that was noticeable during 1916. The larger percentage of adults and the more uniform barometric pressure allowed maximum breeding after the 1919 storm.

A typical observation on the reaction of adult flies to barometric pressure was made on November 21, 1916. Several hundred *Lucilia sericata* and *C. macellaria* were in a cage at the laboratory and under observation. They became very active from 9:00 a. m. to noon and during this time the temperature increased from 66 to 75, the humidity fell from 87 to 60 per cent, the wind was blowing a light breeze from the northeast, the barometer rose from 29.05 to 29.15, at 2:00 p. m. the temperature was 74, humidity 56, the wind a light breeze and a little more from toward the east, the barometer was 28.95 inches, the flies were all quiet and most of the Lucilia were in hiding. The day was clear except for a few medium cumulus clouds clearing toward evening. The barometer fell slightly until 6:00 p. m., when it began to rise and the wind changed to the northwest blowing in a strong norther.

The following observation gives some light on the effect of barometric pressure on the death rate of adult *C. macellaria*, showing that the adults apparently will not chill and die under the effect of a rising barometer as under a lowering barometric pressure. The adults under observation on November 24 were taken in the open and put in a cage November 20 and 22, a total of 366. The adults under observation November 27 were taken under the same conditions November 25 and 26, a total of 500. Between noon and about two o'clock on each date observations and counts were made of the dead flies on the floor of a cloth cage 2 ft. cube with board bottom, this cage being inside of a 6 ft. cube cage made of screen wire. November 24, the first cage contained 87 flies alive and 279 dead flies. Nov. 27, 83 dead flies were taken from the second cage and the others became active in a warm room. Thus showing a 76.2 per cent mortality in the first case under a falling barometer as compared with a 16.6 per cent mortality in the second under a rising barometer. It is believed that other conditions could not have caused this wide difference in mortality. The following table gives the weather conditions under which the observations were made:

1919	Temperature		Barometer		Humidity	
Date	Maximum	Minimum	8:00 A. M.	8:00 P. M.	Maximum	Minimum
Nov. 23	75	61	29.45	29.15	93	65
24	70	55	29.05	28.90	98	87
26	79	48	29.05	29.00	87	36
27	54	48	29.25	29.35	98	86

Observations made at lights and at room windows at nights indicate that insects attracted to lights are more active during high barometric periods and especially while the barometer is rising. No specific determinations have been made to indicate the relative degree of reaction of different species under any particular condition.

Bred adult Diptera tend to emerge on periods of rising barometer, the heavy emergences apparently always have been during high barometer. Trappings and observations indicate that Muscoid diptera are most abundant during long periods with slight variations in barometric pressure, provided, of course, temperature, humidity and rainfall are favorable.

Migration of *Lybithea bachmanni* was observed during the summer and fall of 1916 to take place after storms which indicates that the flights were during high barometric pressure.

THE CONTROL OF BREEDING OF YELLOW FEVER MOSQUITOES IN ANT-GUARDS, FLOWER VASES AND SIMILAR CONTAINERS[1]

By James Zetek, *Entomologist, Board of Health Laboratory, Ancon, C. Z.*

We find, continually, larvæ of the yellow fever mosquito (*Aedes calopus* Meigen) in ant-guards, flower vases and similar containers. We have ample protection from yellow fever due to our intensive sanitation and efficient quarantine, and perhaps, also, our *calopus* population is so low that no danger exists. But not all places are as fortunate as Colon, Panama City and the Canal Zone. Hence any method that will aid in the reduction of *calopus* breeding will have ready application. The method proposed in this paper is not offensive, it is easy to apply, and should result in a great diminution of these mosquitoes. Properly carried out it should eliminate a great deal of friction between the public and the sanitary corps.

I am greatly indebted to Mr. Ignacio Molino, Jr., entomological laboratory assistant of the Bureau of Entomology, U. S. D. A., stationed at the temporary field station at Ancon, for placing at my disposition his big garden in Panama City, for carrying out experiments there, and for making the routine inspections. This garden had forty-six ant-guards protecting choice rose bushes from the nightly ravages of leaf-cutting ants.

To merely empty out the water each day or so, and again refil, is not enough because the calopus larvæ cling tightly to the bottoms of the guards. The usual practise has been to pour some of our larvacide, or some crude oil, into the ant-guards. This "fixes" the larvæ, but the rains wash out this insecticide, it gets at the roots of the rose bushes and as a result many of these are killed. Their productivity is always greatly lowered. Sometimes the ant-guards are purposely broken so they cannot hold water, a simple, effective way out of a difficulty: but this gives no protection against the ants. These measures, therefore, only anger the owner and cause considerable ill feeling toward the sanitary corps. But this is not all; usually after finding larvæ or pupæ the second or third time, the owner is fined. This cannot leave him in a happy mood. As a result, coöperation suffers. Yet, the owner is not always to blame. The mosquitoes are domestic in habits; they must breed; ant-guards are favorable habitats for them. And, man has right to flowers.

Vases in houses have always been prolific *calopus* breeders. It is also difficult to inspect thoroughly every house, and as a rule, the fact

[1] Published by permission of Col. H. C. Fisher, Chief Health Officer, The Panama Canal.

that the sanitary inspector is on his tour is made known long before he arrives. The people soon learn to fear flower vases, hence many will hide them so the inspector will find none. Here, also, fines are about the only outcome, and the result is the same as with ant-guards,—ill feeling toward the well-meaning sanitary corps. But, if the people know that there is a substance which they can place in their flower vases and thereby prevent *calopus* breeding, especially so when the substance will not affect the flowers, then coöperation increases and the sanitary inspector can do more thorough work. The days of actual ignorance as to the importance of yellow fever are gone; nearly all of Central and South America wants to clean up and get rid of this scourge. Hence it is believed the people will fall into line and be of real service in this work of eradication, especially so when all frictions between them and the sanitary forces are made as few and as small as possible.

Other containers exist in houses. Of these the ant-guards used to protect tables and ice boxes from ants, are as easy to control as are the ant-guards in gardens. But the *tinajas*, or water reservoirs, are somewhat difficult to handle because the people must have drinking water, and in tropical climates the *tinajas* keep this water cool. The best control is to substitute them with a water pipe system and a good, clean reservoir and such other means as will give these people good drinking water in sufficient abundance. Not all places can afford a first class water system, hence the sanitary corps must aim, by means of periodic inspections, to have *tinajas* cleaned out and kept free from yellow fever larvæ; at any rate pupæ should never be found. It is remarkable how much a water pipe system reduces the number of containers, and as a consequence *calopus* breeding, in houses.

Another application of the method proposed in this paper, is in the urns containing holy water in the Catholic churches. These always will breed yellow fever mosquitoes unless some method of control is undertaken; it is not an infrequent sight to see the congregation scratching their ankles while the services are going on.

The method proposed consists of adding small quantities of powdered camphor or para-dichlorobenzene to the containers. Lump camphor may be used in flower vases and holy water urns. Naphthalene was found to be unsatisfactory unless used in finely powdered form. About two grams per liter of water was found to be enough, but no minimum dose was determined because it was thought best to be on the safe side. Outdoor conditions, especially heat, rain and débris modify considerably the character of the contents of the container, hence enough of the chemical should be used, and two grams per liter was found to be satisfactory if repeated once a week during the rainy season.

It is believed best that the central station of the sanitary department should keep on hand a supply of the para-dichlorobenzene and sell this to the people at, or nearly at cost. This measure will prevent high costs and will place the substance within easy reach of all. After the details of the application of the insecticide have been made known, then no excuse should be held valid for having *calopus* larvæ in such containers, and if the town has yellow fever, then the offenders, no matter who they are, should be dealt with to the fullest extent of the law.

The following is a brief synopsis of our experiments: (1) A preliminary test was made at the laboratory using camphor and para-dichlorobenzene in powdered form, one gram to a liter of water. Twenty-five *calopus* larvæ were placed in each jar. The camphor floated on the surface whereas the other substance remained on the bottom. The larvæ showed greater distress, at first, in the camphor jar. Three hours later all larvæ were found on the bottom of the jars. Those in the para-dichlorobenzene lot were in great distress, due, of course, to the greater concentration of the substance at this level. There were only five larvæ alive in this jar, but they were unable to wriggle up to the surface. In the camphor jar there were eight larvæ still alive. These tried at times to reach the surface, but were repelled when near it by the camphor in the water. Two hours later all larvæ, in both jars, were dead. In the control lot, the larvæ behaved as *calopus* larvæ should, pupated in due time, and adults emerged.

To determine whether the camphor or para-dichlorobenzene impart any odor to roses, or in any way affect their duration, three roses were placed in a jar containing a liter of water and two grams of camphor; three were placed in another vase containing instead two grams of para-dichlorobenzene. A check lot was also kept. After two days no change in color took place. The roses were then submitted to several people at the laboratory to note if any change in odor was noticeable. There was no change noted, in fact, the flowers looked exactly like the control lot.

(2) A similar test was made with pupæ; one gram of camphor, and one gram of para-dichlorobenzene to a liter of water was used. Three hours later all the pupæ in the para-dichlorobenzene jar were dead and on the bottom. In the camphor jar all pupæ were at the surface: three out of the ten were dead, but the living were in very great distress. Upon shaking the jar to make them descend, they found great difficulty in again reaching the surface. One hour later all pupæ were dead.

(3) A large screen cage, 3 feet by 3 feet by 3 feet was used. In it were placed three moistening jars, 10 inches in diameter by 3 inches high, each with a liter of water. To one of these was added

powdered para-dichlorobenzene (2 grams); in another was placed powdered camphor (2 grams); the third was kept as a breeding chamber for *A. calopus* and received at frequent intervals larvæ and pupæ. Raisins and dates were used as food for the adults that emerged, though at times I would place my forearm against the screen and allow twenty-five fortunate mosquitoes to have a blood meal. Several hundred adults were always in this cage, and copulation in the air was a very frequent sight. The object of the experiment was to learn whether the mosquitoes will appear in the treated waters. The test was continued for one month. During this period *no* larvæ were found in the treated waters. In the breeding jar, however, there were a large number of very young larvæ, showing that oviposition was taking place. Enough water was added to all jars to make up for loss due to evaporation. It would appear that both camphor and para-dichlorobenzene act as repellents.

(4) This experiment was made in Mr. Molino's garden, and was carried out to learn the efficacy of the method under actual field conditions. The garden is divided into two parts, each with about the same number of ant-guards. All of these were emptied, scrubbed out well and allowed to dry for three hours. They were then filled with tap water. To ten of these was added powdered para-dichlorobenzene, two grams to each guard. To ten others, powdered camphor was added, two grams per guard. These twenty treated guards were well scattered among the others. Six days later the first inspection was made. No larvæ were found in the treated guards. Nearly all of the controls had larvæ. During this 6-day period we had twenty-six hours of fairly heavy rain. This test indicates that the method proposed is effective.

The infested ant-guards were emptied, scrubbed out and filled with tap water. The twenty treated guards were left exactly as they were. Five days later an inspection was made; this was eleven days since the chemicals were first introduced. Three of the camphor treated guards and two of the para-dichlorobenzene ones had larvæ. Six of the controls had larvæ, much greater in quantity than in the infested treated guards. We had seven hours of rain during this 5-day period. This test shows that both camphor and para-dichlorobenzene are effective in inhibiting the development of *calopus* larvæ, but due to the rains and the heat, it is necessary to add fresh chemicals once each week. But, even if ten days pass before fresh material is added, there is little danger because it is highly improbable that any larvæ that may be present would reach the pupal state.

(5) It was now thought that perhaps the chemicals could be used in lump form as well, and perhaps be effective: also, that perhaps the

ordinary naphthalene moth balls would be as good. Camphor was eliminated on account of its cost. One half of the ant-guards were given lump para-dichlorobenzene, the other half one moth ball each. A week later five of the moth ball guards had larvæ and one of the para-dichlorobenzene also. It was evident that for ant-guards lump chemicals are not as effective.

All ant-guards were now scrubbed out and left to dry for three hours. They were then filled with tap water and each of them was given two grams of powdered para-dichlorobenzene. A week later, no larvæ were present. Without any cleaning out, two grams more were added to each guard. A week later, no larvæ were present. It is believed this test proves the efficacy of powdered para-dichlorobenzene in controlling mosquito breeding in ant-guards.

It was noted that adult yellow fever mosquitoes were very abundant at first, but as these tests continued, they became less so, until when a month later, there were very few present. It was also noted that insects, particularly wasps, would be found dead at the ant-guards that had para-dichlorobenzene, evidently killed by the chemical in the water.

It may be well, at this point, to recall the experimental work of Dr. J. W. Scott Macfie[1] with common salt. He found that 2 per cent and upwards was effective, this being due to hypertonicity of the solution. In the case of para-dichlorobenzene, the action is due to the slow evaporation of the chemical with the result that the heavy vapor leaving at the surface of the water is breathed by the larvæ and is toxic to them. It forms a sort of blanket between the surface of the water and the air, thus shutting off the air supply.

(6) The following laboratory experiment was made to find out the relative value of camphor, naphthalene and para-dichlorobenzene in both powdered and lump forms. Six jars were used, three for lump and three for powdered chemicals; each was given one liter of tap water and two grams of the insecticide. The camphor floated on the surface while the other two sank to the bottom, excepting for a very small quantity of the finely powdered portion which floated on the surface film. Each jar received 25 healthy *calopus* larvæ. Three hours later (7:15 p. m.) the first observation was made. All larvæ in the jars having lump chemicals were alive, but those in the camphor showed considerable distress. These were trying to remain as much as possible below the water surface. The lump naphthalene and lump para-dichlorobenzene jars showed the larvæ at the surface mostly, and if they did descend, they would not, as a rule, go clear to the bottom

[1] 1914—A Note on the Action of Common Salt on the Larvæ of *Stegomia fasciata*. Bul. Ento. Research, iv, pt. 4, pp. 339–344.

where the chemicals were, but if they did, they would react suddenly upward upon coming into contact with same.

The jars with the powdered insecticides told a different story. Three hours after the larvæ were placed in them, many dead larvæ were found. In the camphor jar only four larvæ were alive; para-dichlorobenzene had six live ones; naphthalene had twelve alive. Two hours later showed no change in the latter jar, but in the camphor and para-dichlorobenzene lots, all were dead. The following morning at 7:30, there were still two live larvæ in the powdered naphthalene jar, but these were dead by noon. At this same hour the lump naphthalene had all of the 25 larvæ alive and *active*, as if nothing out of the ordinary had happened. The lump camphor had but four live larvæ, while the lump para-dichlorobenzene had sixteen live ones. At 4:30 p. m. that same day, all larvæ in the lump camphor jar were dead, while in the para-dichlorobenzene there were still ten alive. There were no deaths in the naphthalene jar.

The next day at 4:30 p. m. there were four live larvæ in the lump para-dichlorobenzene jar, and eighteen in the lump naphthalene one. Twenty-four hours later all larvæ in the para-dichlorobenzene were dead, but in the lump naphthalene there were still about twelve alive, of which two had pupated. These tests show that the substances in powdered form are most effective, that camphor and para-dichlorobenzene are the best, and that naphthalene is uncertain. For ant-guards powdered para-dichlorobenzene is best, but for flower vases and holy-water urns, lump camphor may be used.

(7) A similar test was made with pupæ only. Only camphor and para-dichlorobenzene were used. The lump chemicals were inefficient. The powdered forms killed all pupæ in four hours.

(8) If equal amounts (by weight) of camphor and para-dichlorobenzene are heated in a flask, they melt and form a liquid which remains a liquid at ordinary room temperatures. Preliminary tests showed this combination had good insecticidal properties, and should have ready applications under special environmental conditions. However, not enough experimental work was done with this to warrant making any deductions at this moment. This liquid settles on the bottom in the form of a flattened sphere, and may, therefore, be used with good results in holy-water urns, being less objectionable than the powdered substances.

Summary

About two grams or more of para-dichlorobenzene, repeated every seven days during the rainy season, or every ten days during the dry season, was found to prevent the breeding of yellow fever mosquitoes

in ant-guards. It is necessary that the para-dichlorobenzene be used in powdered form and be well scattered in the guards.

About two grams of powdered para-dichlorobenzene, or the same amount of camphor (either lump or powdered) was found very effective in preventing the breeding of yellow fever mosquitoes in flower vases and similar receptacles. It should be repeated every fifteen days, or each time the water is changed. For holy-water urns, especially in churches, lump camphor is recommended.

The use of these insecticides should be considered obligatory, and if, after due notice has been given, breeding is found, especially pupæ, then the offender should be dealt with severely and to the full extent of the law, particularly so if yellow fever exists in the community.

The central station of the sanitary corps should have these insecticides on hand and sell them to the public at, or nearly at cost.

MOSQUITO CONTROL IN A SOUTHERN ARMY CAMP

By S. M. Dohanian, *Bureau of Entomology, Melrose Highlands, Mass.*

Early in the spring of 1918, the writer, then an enlisted man in the Signal Corps, U. S. A., was transferred to the Medical Corps at his request, and assigned to the problem of insect control at Kelley Field, the large aviation camp located about six miles southwest of the City of San Antonio, Texas. The most important feature of the insect problem was that of mosquito control and the prevention of the breeding of the house fly. This paper will be limited to that phase of the work dealing with mosquito control.

As it would have been rather unwise to devote the entire efforts to removing breeding places in the camp proper and to pay no attention to the surrounding country where the insects might breed unmolested and fly to the camp, it was decided to cover a territory embracing the camp itself and a zone around the camp of about three miles, for unless conditions are especially favorable fresh water mosquitoes will not fly such a long distance. Exclusive of a portion of the City of San Antonio, which comes within this three mile zone, the population outside of the reservation is a little more than 450, with almost 80 per cent of them living in the small "emergency" town east of the camp, known as South San Antonio. The remainder live on scattered farms east and south of the reservation, while to the west there are practically no houses.

The camp site was originally an immense cotton field, having a deep clay soil with only an occasional bed of sand or gravel protruding above this clay formation; and while it was almost uniformly level there were depressions of varying sizes which, owing to the nature of the

soil, retained water for some time after a rain. In the three mile zone the terrain to the north, east, and southeast is similar to that of the camp but devoted to the growing of cotton and truck garden crops, while to the west and southwest the rolling country is covered with mesquites and cacti.

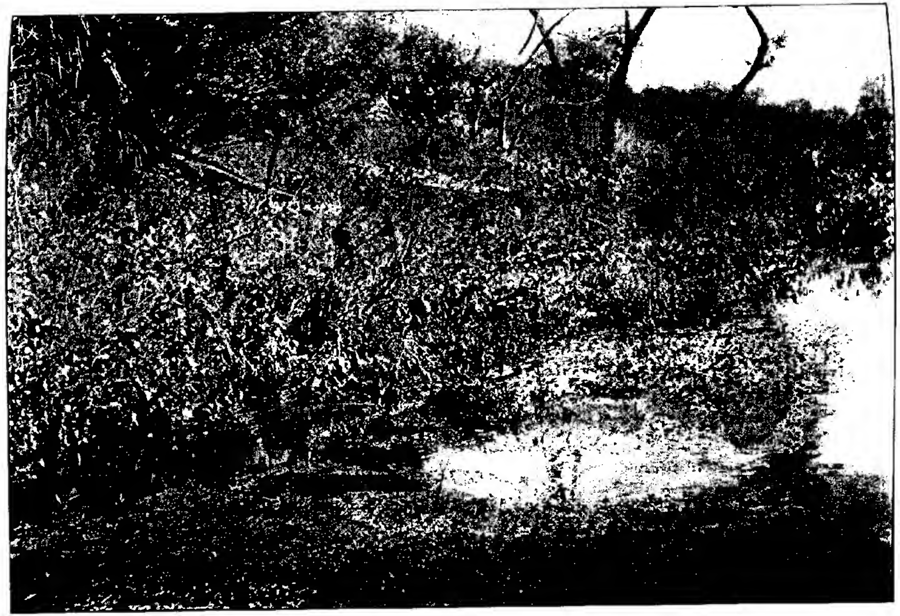
Upon commencing the work of mosquito control in April, 1918, the necessary work of becoming familiar with conditions within the camp and the territory adjacent to it, within a radius of three miles in all directions, was quickly completed. Each and every source of mosquito breeding, hidden or exposed, within the limits of the reservation was carefully noted for future action. Kelley Field, like all other army camps built during the recent emergency, was constructed in great haste. Consequently it caused no surprise to find gutterless roads, depressions under buildings, hollows in the open, leaky fire hydrants and underground pipes, etc. Since it was impossible to remedy all these defects at once, periodical trips of inspection were made throughout the season; all the apparent dangerous sources being visited every nine or ten days, while no effort was spared to cover the camp in its entirety at least once a month. An oiling crew of three men, one of whom was thoroughly instructed in the objects and methods of spraying and who was always in charge of the crew, would spray all temporary pools of water in which mosquitoes were found breeding. Under prevailing atmospheric conditions it was found that a combination of crude oil (70 per cent) and kerosene oil (30 per cent) gave the most desirable consistency and the best results. Because oil interferes with the proper functioning of sewage disposal plants, no oiling was done on the surface of waters which would eventually find their way into the disposal plants. Several times during the early season mosquito larvæ were found breeding in the flushing tanks of unused sanitary latrines. Since no oiling could be done in these places a man was detailed to flush weekly all temporarily unused latrines.

One of the duties of the camp entomologist was to collect, bi-weekly, specimens of mosquitoes found in the reservation for shipment to the Army Medical Museum, Washington, D. C. (as required by army orders), for a study of the relation between disease-bearing mosquitoes and local prevailing diseases. The effectiveness of the above method of inspection and subsequent treatment is testified to by the complete absence in Kelley Field of the yellow fever mosquito, *Aedes calopus* (which is known to breed in chance water in receptacles about buildings), during the entire season of 1918, although several specimens were collected in San Antonio. The following is a complete list of the species of mosquitoes found at Kelley Field during 1918, as identified by the Army Medical Museum, Washington, D. C.

Culex tarsalis; C. fatigans; C. spissipes; C. chrysonotum; C. similis; Psorophora jamaicensis; P. texanum; P. signipennis; Mansonia spp.; Anopheles crucians; A. punctipennis; A. pseudopunctipennis.

The most prolific of the above mosquitoes was *Culex fatigans*, having been found breeding from April to December inclusive; while of the Anophelinæ the commonest was *Anopheles pseudopunctipennis*, which was found breeding throughout the summer months.

The sluggish Leon Creek, which for more than four miles meandered within or in close proximity to the reservation, was at the outset condemned as the place from which would come most of the mosquitoes. In parts of its course it formed pools more than an acre in area. Its course lay through a wide ravine, in places the banks rising fifty feet in height; nowhere was it entirely free from a tangled mass of weeds and tall grasses, on the whole having the general appearance of a typical jungle (Plate 6)—an ideal source for the most prolific propagation of mosquitoes. To reduce or even eliminate as much as possible mosquito breeding in this place through the period of construction, resort was made to the use of the oils. The first two attempts were local failures. In both cases frames of wire mesh were built to fit snugly into a narrow portion of the creek near the place where it first enters the reservation. These forms were boarded on the two sides which were to be placed against the banks of the creek. The bottom, the two sides facing the direction of the stream and the top cover were made of wire mesh. This rectangular frame (about 30 inches by 36 inches by 12 inches) was filled with sawdust which had been soaked in crude oil for six hours, and then placed in position in the creek. This proved unsatisfactory because of excessive oiling for 24 hours following submergence, and because its effectiveness was of comparatively short duration, and therefore demanded frequent attention. An attempt was made to overcome these difficulties by substituting excelsior for the sawdust, but with approximately similar results. The third trial, of using a large 50 gallon oil drum as a drip, was successful. This drip was placed over the channel leading from one of the sewage disposal plants into Leon Creek. Two heavy planks stretched across the channel supported the large oil drum in such a position that the nozzle pointed into the middle of the stream. To assure the complete breaking up of the oil drops at all times as they fell into the water, two or three medium sized rocks were placed in the bottom of the channel just in front of the spot where the oil drops hit the water. These rocks caused a ripple of sufficient force to break up each drop and at the same time to direct the oil to the two sides of the channel. The same proportion of crude and kerosene oils (70 per cent to 30 per cent), which was used for general spraying, was found to be satisfactory for use in



the drip. In this manner the creek was supplied, throughout the period of construction, with a steady, uniform, and a very thin film of oil. Impurities and heavy ingredients in the oils necessitated weekly adjustments of the nozzle of the drum. Extreme care was constantly exercised to drip the minimum amount of oil necessary for the prevention of mosquito breeding, to eliminate any danger to live stock using the water down stream, and to the colonies of top-minnows living within it. In several places along the banks of the creek springs caused permanent pools of fresh water, into which top-minnows were introduced to good advantage.

It was evident that the true condition of the creek was not appreciated by the authorities until their attention was called to it by the writer upon assuming the duties of camp entomologist. On May 1, 1918, only seven Mexican laborers were engaged in improving the creek, the work being to clear the banks of the vegetation. Had its real dangerous character been realized more than seven times seven men would have been employed early in the season before the advent of mosquitoes. Considerable filling, cutting and grading were necessary to secure a thoroughly sanitary condition, particularly if the improvements were to be of a permanent nature. And the ultimate object of the anti-malarial construction was the permanent eradication of mosquito breeding in the creek. Accordingly requisitions were made not only for an increase in the number of Mexican laborers but also for as large a number of enlisted men as could daily be spared from other necessary duties to work upon this project. Because of the complex military methods of procedure some little time elapsed before the number of Mexican laborers was increased from seven to an average

Nature of work		June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Totals
Policing the creek (Figs. in linear ft.)		6,700	8,325	6,750	6,800	9,550	7,660	5,500	51,285 lin. ft.
Banks treated (Figs. in linear ft.)		2,100	7,300	1,200	850	575	575		12,600 lin. ft.
Re-sodding (Figs. in sq. yds.)						6,200	8,400		14,600 sq. yds.
Cuts made (Figs. in cubic yds.)		343.8	512.5	475.1	338	521.5	826	320.3	3,337.2 cu. yds.
Fills made (Figs. in cubic yds.)		826.7	1738.2	2643.6	4170.1	3281.	2099.3	2234.4	16,993.3 cu. yds.
Oil used (Figs. in gallons)		65	60	50	60	60	55	35	385 gallons
Average Labor	Soldiers 6 hours/day	17	7	4	9	3	6	3	7 men per day
	Mexicans 8 hours/day	10	16	27	24	25	25	21	21 men per day

of about twenty-five. The additions were, however, gradual. The number of enlisted men available fluctuated considerably, ranging from none to fifty men daily, but with a rather low average, as will be seen from the accompanying table.

The above table gives summaries of the work accomplished monthly during the period of extensive construction on Leon Creek. The work in certain places was expedited by the use of about 200 pounds of dynamite and 35 pounds of black powder. Such necessary implements as picks, shovels, plows, scrapers, etc., used in the project were army properties. During this period an average of four double teams (of two mules each) were used for 64 days.

Had the anti-malarial construction commenced early in the spring of the year the work would have been planned on a different basis than that actually carried out. However, due to the lateness of the season the initial work was planned to consist merely of building a narrow central channel along the entire length of the creek, to grade where necessary for a steady flow of water, to fill such pools if grading did not entirely drain them, to eliminate standing pools, and to clear the banks of vegetation and other matter which would interfere with the flowage thus giving opportunity for the propagation of mosquitoes. Following this preliminary work (Plate 7), which reduced mosquito breeding sources to a minimum, the narrow central channel was permanently graded and the banks of the creek regraded where necessary, and sodded, to withstand washouts by the heaviest rains (Plate 8). This last phase of the work was well under way and nearing completion when, the Armistice having been signed, the writer was discharged from the service late in January, 1919.

Since the jurisdiction of the army authorities was confined to the limits of the reservation our work was limited to those portions of Leon Creek which were within that area or formed parts of its boundaries. However, the United States Public Health Service, with branch headquarters in San Antonio, under the direction of Major Gardner, appropriated a sum of money sufficient for the undertaking of improving the creek outside the camp bounds. The work done by them, although of material benefit in the reduction of the pests, was of a temporary nature. The splendid coöperation between the two government departments was productive of wonderful results, as was noted by Colonel Lewis, Sanitary Officer of the Medical Department for the Air Service, while on a tour of inspection of the Flying Fields, at Kelley Field in July, 1918, by the following remark, "There are very few flies in the camp and no mosquitoes."

PROFESSIONAL ENTOMOLOGY: THE CALL AND THE ANSWER

By Edmund H. Gibson, *Consulting Entomologist, Washington, D. C.*

It is always fitting that at the outset or beginning of any new endeavor or activity a definition or explanation be made of the new undertaking, especially in its relation to the old and established. Therefore, permit me to refer to professional entomology as the study and application of economic entomology for the means of a livelihood, in which one's services are sold in competition and in which one capitalizes his knowledge and places his attainments and abilities on a business basis.

Young men and women are attracted to science, in its various branches, by fascination, curiosity, the love of study, and desire to add to the world's knowledge. Remuneration for one's work has been secondary. Possibly, rightly so. But does the lawyer's desire for worldly gain and the doctor's fee detract in any way from their practice and professional or scientific ability? Rather is the money return a beneficial factor for furthering of study and bettering the professional man's ability to do increased good to his fellow men. If this is so, then those who in the future think more of financial gain than their comrades do must not have the criticism thrown against them that they are selling or prostituting science.

The writer can see no reason why entomology cannot or should not be put upon as dignified a business basis as law, medicine or engineering. There was a call for men able to state and argue facts; the lawyer was the result. There was the need for men skilled in treating and curing the sick; the doctor was the result. There was wanted those who could plan and supervise construction of all kinds; the engineer was the result. In the main, those who entered these and various other professions did so because of the need or call assuring at least fair returns for time spent in study and preparation, and unusual opportunities for financial gain, in return for ability and attainments. The call in other professions has been made and answered. Is there a call for professional entomology and is it being heard at the present time?

There was recently formed in one of our large western cities a farming corporation, with large financial backing. This company owns and operates extensive farm lands in the South. They grow and market immense crops of various kinds. Naturally, there are losses due to insect injury. Who is their consulting entomologist? They have none. Why? There was none. Why have they not called in the state entomologists, university professor, or the laboratory assist-

ant, whose services they can have free of charge? Because the men directing the affairs of the corporation are business men and want dealings with men of technical skill, with appreciation for business methods, and think more of advice paid for than given free. The pure scientist and research worker cannot be a business man; even if he were he would be forced, by institutional connections, to extend his advice prepaid.

A certain company in one of our northern states operates a chain of graineries. Each year they meet with severe insect damage, because there has been no professional entomologist who can plan and carry out fumigation operations. There is plenty of government and state literature at hand telling how to do this and that. But who is to do it?

A thriving city of nearly 50,000 inhabitants, the capital of one of the greatest states in the Union, has tried all kinds of methods of garbage disposal during the past three years. Recently, a pig farm at the outskirts of the city was established. During the summer months the city was deluged with flies. But few knew where the flies came from, and none knew how to get rid of them. Consultation with a professional entomologist would have led to fly eradication and bettered conditions. And the bill rendered would have received prompt attention.

It would be possible to go on indefinitely enumerating the openings and opportunities of consulting and contract entomologists, as you all know the field of entomology in its various branches and phases is almost limitless.

There was never a better time than to-day to establish oneself, to become known as a consulting or professional entomologist, to open up and to develop the avenues of usefulness in the conservation and production of all articles and stuffs entering into the daily existence of man.

Who will answer the call? The answer to this question is rather hard to foretell, but I might venture to suggest that success will more surely come to him who goes into professional entomology from a conservative standpoint. A certain amount of capital will be required to tide oneself over the months consumed in getting established, an office or at least desk space is necessary, a certain amount of circularizing or advertising will be found quite essential. And then there must be a reserve fund to fall back on for operations, until such operations bring in their returns.

Even a meagre and humble start will entail considerable expense. After a few individuals or firms of consulting entomologists or entomological engineers are well established, there will be openings in such firms for junior or assistant entomologists, such positions paying livable salaries.

The suggestion has been made to the writer that a professional entomologist should have a line of insecticides for sale, in other words, combine the commercial with the professional. In some rare cases this might work out to advantage, but I firmly believe that in the majority it will be more harmful than helpful. I came to this conclusion by the fact that few lawyers sell law books and doctors do not sell their medicines. There is the distinctive commercial field and also the consulting practice. Some may choose one and some the other.

No one consulting entomologist will be able to cover all phases of entomology in his practice, any more than the research worker or systematist. The attempt must not even be made. Consultation with others better informed upon certain problems must be frequent. The quack doctor runs a bluff game. A bluffing doctor only discredits himself, but in the case of a new business profession the bluffer will discredit his profession, as well as himself and his co-workers.

There must be close coöperation between the laboratory and field research worker and the professional consulting or contracting entomologist. The latter must turn to the former for certain fundamentals and the former will have to look to the professional for the strictly practical application of his methods.

The few who have already chosen to be pioneers in this new profession are sincere, modest, and we trust will prove capable.

THE VALUE OF FIELD DEMONSTRATIONS IN EXTENSION WORK IN BEE CULTURE

By L. B. Crandall, *Storrs, Conn.*

All extension workers have found that the best way to get information to another person is to carry it to him, and the best way to get him to use it is to show him how.

This is also true in other lines of education; hence, we have in nearly all of our schools, laboratories and workshops for many lines of study. You can tell a man how to do a certain task by means of a book, bulletin, or personal letter, but he will often get from that description a very different picture from what you intended. If you go to see him and demonstrate what you mean, he will get your idea clearly.

All men interpret what they read, more or less, from the background of their own experience. If their experience has not been somewhat similar to yours, they cannot interpret correctly what you write.

For these reasons I believe that field demonstrations form the most important part of extension work.

It is quite generally agreed, I believe, that a bulletin without pictures to illustrate its text is practically useless to any person who lacks

a background of experience in the subject. A demonstration adds as much to the work of an extension specialist as pictures do to the text of a bulletin.

There are many ways in which field demonstrations are valuable to the people of a state. One of them is to interest more persons in the possibilities of beekeeping. This is brought to the attention of the greatest number, perhaps, by exhibits of honey and bees at the state and county fairs. If these exhibits are accompanied by public demonstrations of handling bees in practical, up-to-date ways, much valuable information can be imparted to the public. When these exhibits are well handled, a good deal can be done to advance better beekeeping in the state.

I believe there is no great value in the so-called "stunts," except to draw a crowd, but if demonstrations are well conducted by competent beekeepers, they may be valuable extension work. I think it might be well for the Extension Service to lend encouragement and supervision to this class of demonstration work.

One of the greatest values in field demonstrations is in showing beginners right methods of handling bees. Beginners are more or less afraid of bees. They know that bees sting, and, naturally, are somewhat afraid of being hurt. They may never have seen a hive opened, so do not know what to do first. The inside of the hive is all mystery to them. They do not know what will happen when they take off the cover for the first time. They rather dread the first step in investigating the inside of a hive filled with live bees. When the demonstrator comes along with his assurance of knowledge and his confident manner of handling the smoker and hive tool, the fear and the mystery vanish. It does not seem to be such an ordeal to open a hive. Beginners gain confidence and forget their timidity. They come up nearer, alive with interest, to get all the information they can of the best ways of doing things with bees. At such a time a good demonstrator can render very great help to the beginners in his audience and gain their coöperation in all his future efforts in their communities.

The New England farmer is conservative. He is slow to adopt new ways of doing his work, or of taking up the use of new tools for doing the old tasks. *The field demonstration is practically the only way by which he can be made to see any advantage in new equipment.* This also applies to new methods of doing work. The way grandfather did it is too often the way the grandsons still do it.

The field demonstration gives the extension specialist a good chance to show the value of new equipment or improvements on old equipment as they are developed. Improvements in ways of handling bees, discovered by the federal and state research workers, are passed on to the beekeepers in the best way by means of field demonstrations.

Comparatively few beekeepers in the United States are conversant with the advance work being done for them by the research specialists at Washington and elsewhere. This information must be carried to the great majority of the beekeepers, and its value demonstrated, or they will never know that anything is being done for them. This kind of work has especial value to the commercial honey producer, and this is often the only kind of service which the extension worker can give such men.

Most commercial honey producers are alive to the best interests of their business in respect to increased production. They are ready to adopt improved methods of apiary management when they can be shown that such improvements are to their advantage. They have considerable money invested in equipment, and it is often expensive to make the necessary changes incident to the adoption of better equipment or to any radical departure in the apiary management. It is necessary, therefore, that the extension worker should be careful not to try to introduce new methods or new equipment until they have been thoroughly tried out and proven to be practical.

Swarming and its control are always interesting subjects for beekeepers everywhere. They are ready at all times to adopt new methods which promise a solution of this old problem. Much valuable work can be done along this line by field demonstrations.

One of the most, if not the most, important uses of the field demonstration is in diagnosing brood diseases. No amount of printed matter, even with good engravings, can make clear the difference between brood diseases. A good demonstrator can show his audience samples of each kind of disease and point out the peculiarities of each. For cases of these diseases where there are no complications, this method works very well, but in cases complicated by the presence of other organisms, only a microscopic examination will prove effective. The demonstrator of brood diseases should have a good microscope as his most important tool. At the same time the demonstrator can and should give the beekeepers an outline of the value of apiary inspection work in the control of brood diseases. It would be well in most cases if the demonstrator would also point out the fact that the inspector is the friend of the beekeeper, and that he is willing and anxious to help the beekeeper to clean up his diseased colonies and show him the best way of keeping clear of infection in the future.

The demonstrator can also make it plain why inspection work must be thoroughly done to be of any value, and why the inspector must thoroughly disinfect himself and his tools before going to another apiary. This last point is one which should have more attention from the person having state inspection work in charge.

An important office which field demonstrations should serve is that of showing the beekeepers what kind of assistance the Extension Department of their State College can render them. The extension work in bee culture is somewhat new for most of the states, so that the beekeepers have not yet learned to look to the Extension Service for help along this line. This makes it important, I think, that the extension specialist make the field demonstration an important part of his work, especially during the summer.

In our fight to eliminate poor equipment, especially the old box hive, the field demonstration has one of its greatest values. The specialist can easily show why beekeeping under such conditions is unprofitable; how inspection of bees in box hives is impossible and that disease will run riot unchecked; how the hives cannot be manipulated to secure the highest production of honey; and how swarm control methods cannot be used successfully, consequently, colonies often swarm themselves to death.

For these reasons I believe the field demonstration as a means for extension work in bee culture has a great future, and that its possibilities have, as yet, been but lightly touched.

WESTERN TWIG PRUNERS

By Frank B. Herbert, *Scientific Assistant,*[1] *Los Gatos, Calif.*

There are several beetles in the West which prune twigs and small branches from a number of trees. Apparently all are native species, but work upon exotic as well as indigenous plants. They bore into twigs, varying from one-eighth to a quarter inch or more in diameter, often entering where two branches fork and following down the center for a short distance. This weakens the twigs, generally causing them to break down from their own weight or during a windstorm. The small branches usually die back beyond the point of attack, offering excellent entrances for fungi and other insects.

This peculiar habit is not for the purpose of forming a brood gallery nor a breeding place in any sense, but seems to be done in order to obtain food, particularly when a considerable lapse of time occurs between emergence and egg laying.

Single individuals only are found in each burrow. These remain but a short time and then abandon them, presumably to mate and lay their eggs.

Polycaon confertus Leconte (family Bostrichidæ), often called the olive twig borer, is the one most commonly met with. It is a rather

[1] Branch of Forest Entomology, Bureau of Entomology, U. S. Department of Agriculture.

slender brown beetle about one-half an inch long, occurring in California and Oregon. It usually bores in at the forks of two small branches, entering for a quarter inch or more and throwing out considerable frass behind it. Young trees are occasionally quite seriously damaged by the attack of the beetle.

The following is a list of the plants from which the twigs are pruned by this species: almond, apple, apricot, avocado, birch, cherry, currant, English elm, *Eugenia myrtifolia*, fig, grape, live oak, olive, orange, peach, pear, prune, and the strawberry tree (*Arbutus unedo*).

The beetle does not breed in many of these trees, however. Its eggs are laid in the dead wood of acacia, almond, apple, Oregon and silver maple, manzanita, live oak, tan bark oak and rose. The larvæ mine in the sap- and heartwood of these trees for a year or possibly more and finally emerge in the early summer as beetles to perhaps prune a few twigs before producing their progeny. Probably only a very small percentage of the emerging beetles ever assume the habit of attacking the small branches.

There are no practical methods of control for the beetles entering the twigs. Part of the injury might possibly be prevented by the application of repellent or poison sprays, but the trouble seldom becomes serious enough to warrant their use. Hand picking may be resorted to, but the beetle has probably already abandoned the branch when its condition becomes noticeable, or else most of the damage has been done when the beetle is found. The most satisfactory control measures are to destroy all possible breeding places during the winter or early spring by burning all dead logs and stumps of the host plants.

Polycaon stoutii Leconte, a larger, black species, is also reported to prune twigs in the same manner, but has not been observed to do so by the writer. It breeds in California laurel, coast live oak, madrone and manzanita, and attacks the branches of almond and *Eucalyptus globulus*. This species occurs throughout California.

Apate punctipennis (Leconte) (family Bostrichidæ), called the western twig-borer, burrows into the twigs of different orchard trees, particularly apricot, much in the same way that *Polycaon confertus* does. It is a dark brown beetle, about one-half an inch long and differs from the latter in having its head well under the thorax, which bears prominent tooth-like processes. The western twig-borer occurs throughout the Pacific southwest. Mesquit appears to be its native host plant, but it has also been bred from the wood of apricot, fig, grape, pear and orange.

Phloeosinus cupressi Hopkins and *P. cristatus* Leconte are bark-beetles belonging to the family Ipidæ, which also have the abnormal habit of pruning small twigs. These resemble each other a great deal

and are small, stout, cylindrical, brownish black beetles, about three millimeters, or an eighth of an inch long. The habits of the two species are very similar, so they are discussed together. Both are native to California. Dr. Hopkins, in an article in 1903, mentioned the fact that the former was a twig pruner. The writer has discovered that *P. cristatus* is also responsible for part of the injury.

Both breed in a number of cypresses and cypress-like trees, and may even be found working together in the same tree. They attack in numbers and excavate galleries several inches long under the bark, parallel to the grain of the wood, and lay their eggs in small niches on each side of the galleries. Upon hatching, the larvæ mine away from the galleries in the cambium and thus girdle the trees, transforming to beetles at the ends of the mines, *P. cupressi* pupating under the bark and *P. cristatus* a short distance in the wood.

Under certain conditions, part of the emerging young beetles attack small branches about one-eighth inch in diameter, entering through the bark and mining down the centers of the twigs, leaving nothing but thin exoskeletons of bark to support the tips. Consequently, many twigs break down from their own weight. The beetles may do this in order to obtain food or to await the coming of their team-mates in order to make a concentrated attack on the next tree. Beetles are very seldom found dead in a twig burrow, which fact helps to substantiate the theory that the beetles leave them to make brood galleries and rear young elsewhere. One female removed from a food burrow and placed in a cage with a section of cypress, proceeded to make a short gallery under the bark and lay eggs therein. They were apparently infertile, for none hatched, on account of the male placed in the cage having failed to find the gallery of its mate.

Both sexes have been found in the twigs, but always only one beetle to a gallery. They have been captured in the following months: March, June, July, August, October, November and December. Upon careful search, however, they probably could be found during the other months as well. Most of this work is done in the spring and fall, while a majority of the injured twigs drop from the trees during the first heavy windstorms of the fall. Part of the injuries to the trees heal over after being abandoned, but usually a distinct swelling or elbow remains at the point of attack.

To indicate the number of twigs which are often pruned from a single tree, the writer raked together those under an ordinary sized monterey cypress and thus obtained a pile two and one-half feet high and nearly as wide, and still many more remained on the tree, giving it a very dilapidated appearance.

Phloeosinus twig work has been noted on the following cypresses:—

monterey (*Cupressus macrocarpa*), arizona (*C. arizonica*), guadalupe (*C. guadalupensis*), macnab (*C. macnabiana*), funeral (*C. funebris*), italian (*C. sempervirens*), lawson (*Chamaecyparis lawsoniana*), hinoki (*Ch. obtusa*), and arbor vitæ (*Thuya orientalis*), giant arbor vitæ (*Thuya plicata*), and incense cedar (*Libocedrus decurrens*).

The beetles may be best controlled by burning up the infested trees, posts or poles in which they are breeding, or by removing the bark when they are in the younger stages, killing them by exposure. This will reduce the numbers liable to enter the twigs.

The injured twigs may be trimmed from the trees, making them more presentable. Poison or repellent sprays have never been used, but may be of value in preventing the twig injury.

Three specimens of a scolytid bark-beetle were discovered by the writer in broken twigs of ash (*Fraxinus spp.*) on the Stanford University campus in May, 1919. Many other twigs were broken down and wilted, showing the results of their work. Later, upon a closer examination of the ash trees in this locality, a great many of the twigs were discovered to have been entered, while only a small percentage had been broken down. The entrances were found mostly at a bud or the axil of a twig, with the burrows spiralling down the twig under the bark for a quarter inch or more.

The old brood galleries of these beetles were found in the dead tops of three nearby ash trees which had been killed apparently by this species. The parent galleries were under the bark, extending transverse to the limb, while the larvæ which hatched from the eggs laid in niches on the sides of the galleries, mined parallel to the grain of the wood. All the limbs had been abandoned, but a dead beetle was found in a pupal cell, which proved to be identical with those in the twigs.

Upon forwarding a specimen of the beetle to Dr. Hopkins at Washington, D. C., he pronounced it as apparently an undescribed species of *Leperisinus* near *aculeatus* Say. He also stated that an allied species, *L. fraxini*, had been reported to be injurious to twigs in Europe, but that he believed no such injury had been reported in America.

Among other twig pruners may be mentioned *Agrilus angelicus* Horn, the flat-headed oak twig girdler, the larva of which in making its spiral mines under the bark of various oak twigs, which it kills, occasionally goes deep enough into the wood to so weaken the branch that it is broken off by the wind. Two unidentified cerambycid larvæ also work upon larger twigs of oak and sometimes cause the same injury. No work resembling that of the eastern hickory girdler, (*Oncideres cingulata* Say), has been observed in the West.

(Proceedings to be continued in the next issue)

SOME RESULTS WITH NICOTINE AND NICOTINE COMBINATIONS IN EXPERIMENTS ON THE CONTROL OF LASPEYRESIA MOLESTA BUSCK[1]

By Louis A. Stearns, *Associate Entomologist, Virginia State Crop Pest Commission*

Judging from the published results of limited experimental work of both field and laboratory character, uncertain success has accompanied endeavors to control the oriental fruit moth as a pest of peaches. It would seem that the vulnerable point in the life-history of the insect, as well as the insecticide most effective in combating it, are yet to be determined. The writer, in common with others engaged in a close study of the moth, discovered, early, that applications of arsenical sprays to the fruit, foliage and twigs of infested peach trees, although of some occasional benefit to the sprayed trees, in most instances were apparently of negligible value, since the larvæ feed largely within the twigs and fruit. At first, it appeared, also, that applications of 40 per cent nicotine sulphate, either alone as an ovicide or in combination with an arsenical near hatching time, failed to materially control the insect.

However, it has been encouraging to note that in the young, well-cared-for commercial orchards of extreme northern Virginia the moth was absent. The Virginia infestation is primarily an area of small and scattered home-garden plantings. Commonly one third of the twigs of such trees are tunneled out and killed by the larvæ of this peach pest, and an equally high percentage of the fruit is usually "wormy." Although the few commercial plantings, cultivated, pruned and sprayed in conformity with the best orchard practices, are in close proximity to these heavy infestations, the moth has been unable, apparently, to establish itself.

In view of the seeming discrepancy between experimentation and local field observations, experiments were conducted in 1919 with the intent of ascertaining accurately the toxic value of several insecticides, both alone and in combination, in detailed laboratory tests with individual eggs and just-hatched larvæ of the moth, and in limited field tests with single infested peach trees.

The results of the previous season's investigation, which had pointed to the likelihood of controlling the moth most successfully in its egg stage, had emphasized also, in view of the egg-laying habits of the insect (deposition on under surface of leaves), the necessity of increasing the spreading and sticking possibilities of whatever insecticides employed,

[1] The investigation of which these results are a part is discussed in detail in the Quarterly Bulletin, Virginia State Crop Pest Commission, April, 1920.

by their combination with some material possessing these specific characteristics. Sea moss solution (prepared by boiling 4 pounds of "Irish" rock moss for one hour, straining and diluting to 50 gallons of water) and a casein-lime mixture (proportions 1 part casein to 3 parts hydrated lime; rate 1 pound to 50 gallons of water) fulfilled best these requirements. Microscopic examinations have shown that, in instances where the insecticide had failed to kill an egg, and the young larva had succeeded in projecting the head partly through the forty-five degree angled aperture which is made, the thin flakey film of sea moss served often as a barrier to halt the normal hatching process at that point. The inexpensiveness of this material repays largely the time and labor involved in its preparation. Applications of calcium-caseinate resulted in a uniform conspicuous coating of the foliage, which, in field tests, persisted for a number of weeks despite heavy rains.

Laboratory Tests

The method of procedure included the confining of moths in ten-inch breeding cages (double height) in the box bases of which one-year-old peach stock had been planted. Life-history studies in 1918 had shown that a high percentage of infertile eggs were deposited, due undoubtedly to laboratory conditions of confinement. The eggs deposited upon the foliage of these trees were, therefore, given a careful examination with a hand lens. Thus only those eggs which presented a well-rounded normal appearance and were apparently viable entered into the experiments. In applications, which were made with an atomizer, care was taken to hold the atomizer in such a position that only the spray mist floated over the foliage. Twenty-one experiments, comprising twenty-four tests with eight insecticides, in which a total of 2,877 eggs were studied individually under a binocular microscope, were conducted at the Leesburg Field Laboratory. Following applications, each egg was examined daily to observe the effect of the sprays and to secure accurate hatching records.

The results with nicotine in these experiments seem a further contribution to our knowledge of the usefulness of this material, and as such deserve special notice. In view of observations made in experiments of the preceding year, the efficiency of the nicotine-arsenical combinations in Table I has been computed by comparing the total number of eggs not hatching and larvæ dead 36 hours after hatching, with the total number of eggs employed. The percentage of kill for all these combinations in which nicotine sulphate (40 per cent) occurs as a toxic constituent may be computed as 79.69. The results with nicotine sulphate (40 per cent) and sea moss stand alone, 95.40 per cent of the

eggs failing to hatch. The data of these tests showed, in addition, that the efficiency of all insecticides varied directly with the time following deposition at which the application was made. Records indicate an even gradation from 87.95 per cent failing to hatch with application on the day of deposition to 55.78 per cent failing to hatch with application just prior to hatching.

Table I.—Results with Nicotine and Nicotine Combinations in Laboratory Tests with Selected Eggs and Just-Hatched Larvæ of *Laspeyresia molesta* Busck, Leesburg, Virginia, 1919

Insecticide	Formula	Total number of eggs employed	Total number	Per cent
			of eggs not hatching, (and in arsenical combinations) larvæ dead 36 hours after hatching	
1. Arsenate of lime, powder Nicotine sulphate (40%) Sea moss	½-50 1-800 4-50	44	44	100.00
2. Nicotine sulphate (40%) Sea moss	1-800 4-50	587	560	95.40
3. Arsenate of lead, paste Nicotine sulphate (40%) Calcium (3), casein (1)	2-50 1-800 1-50	353	296	83.85
4. Arsenate of lime, powder Self-boiled lime sulphur Nicotine sulphate (40%) Sea moss	½-50 8-8-50 1-800 4-50	62	41	66.12
5. Nicotine sulphate (40%) Calcium (3), casein (1)	1-800 1-50	484	257	53.08

A study of selected unsprayed eggs as check showed that only 8.9 per cent failed to hatch.

Tests with Single Caged Peach Trees in an Orchard

Equally encouraging results have been obtained in limited field tests, in which applications were made to two-year-old infested peach trees enclosed in cages. These trees, from three to four feet in height, had been pruned back well, resulting in an abundance of growth and foliage, which proved an attractive feeding-ground for the first brood larvæ of the moth. On June 23, after cessation of feeding by second brood larvæ, a count was taken of the total number of twigs per tree, also the total number of injured twigs per tree. The percentage of injury based on these counts is given in Table II. 28.34, the average per cent of injury for the entire plot corresponds very nearly with the amount of injury usually found in infested peach trees throughout the infested area of northern Virginia. On June 14, while egg-laying was in progress, applications were made of several insecticides, the results with nicotine and nicotine combinations only being included here.

On July 30, after cessation of feeding by third brood larvæ, percentages of injury were ascertained again by count of infested twigs, the average being 13.38.

The reductions in the amount of injury recorded range from 13.34 to 44.44 per cent; the average reduction for the entire plot was 14.96 per cent. The average percentage efficiency for these insecticides may be computed as 73.3. Nicotine sulphate (40 per cent) and sea moss, arsenate of lime, powder, self-boiled lime sulphur, nicotine sulphate (40 per cent) and sea moss, as two individual combinations show each an efficiency of 80.0 per cent.

Table II.—Results with Nicotine and Nicotine Combinations in Field Tests with Single Caged Peach Trees Infested by Laspeyresia molesta Busck, Vienna, Virginia, 1919

Sprays applied July 14		Per cent injury, June 23	Per cent injury, July 30	Per cent reduction in injury	Per cent efficiency for spray
Insecticide	Formula				
1. Arsenate of lead, paste Nicotine sulphate (40%) Sea moss	2–50 1–800 4–50	20.00	6.66	13.34	66.7
2. Arsenate of lead, paste Nicotine sulphate (40%) Calcium (3) casein (1)	2–50 1–800 1–50	40.00	13.33	26.67	66.6
3. Nicotine sulphate (40%) Sea moss	1–800 4–50	23.80	4.76	19.04	80.0
4. Arsenate of lime, powder Self-boiled lime sulphur Nicotine sulphate (40%) Sea moss	½–50 8–8–50 1–800 4–50	55.55	11.11	44.44	80.0
Check—no treatment		25.00	25.00	Unchanged	

Statement of Results

Nicotine sulphate (40 per cent) diluted 1 part to 800 parts of water employed either alone as an ovicide or in combination with an arsenical in applications near hatching time has, in detailed laboratory tests and in limited field tests with single infested caged peach trees, resulted in a more than three-fourths control of *Laspeyresia molesta* Busck. These encouraging results are yet to be confirmed by experiments on an orchard scale.

Life-history studies show that in northern Virginia the heaviest deposits of eggs are present on the foliage about May 17, June 21, July 26 and August 28. Local applications of nicotine sulphate to be most effective should be made on or near these dates.

AN INTERESTING CASE OF MILK CONTAMINATION[1]

C. S. Spooner

The article by Prof. W. A. Riley, '18, on the presence of dipterous puparia in certified milk, recalls an instance of the occurrence of a dipteron in milk which came to my attention in Georgia while employed by the Georgia State Board of Entomology.

In January of 1914, a sample of milk was sent to the office of the state entomologist containing dipterous larvæ and puparia. The material was turned over to me for rearing. The second day after receipt, adults emerged. They proved to be a species belonging to the family Phoridæ.

The milk was still sweet when received and, as the adult flies emerged in so short a time, it is doubtful if the flies oviposited in the milk. A considerable quantity of dirt was present in the milk and it is probable that the larvæ entered along with the dirt and that the occurrence was accidental. They were able to obtain the necessary subsistence from the milk however, and all the larva present formed puparia and eventually emerged. Unfortunately the source of the milk was never investigated.

Material was sent to Mr. J. R. Malloch of the Illinois State Natural History Survey, to whom the writer is indebted for the determination. The species was *Aphiochaeta scalaris* Tw. Mr. Malloch further stated that *Aphiochaeta ferruginea* Brunetti is a synonym of the above species.

Malloch, '13, states that the larvæ have been recorded as attacking onions in the West Indies, living on decayed insects in Brazil and parasitizing *Hyphantria cunea* in Florida. Brunetti, '12, under the name *Aphiochaeta ferruginea*, states that the larvæ are known to cause myiasis of the intestine in man and that it is able to complete its life cycle in the intestine.

Brues, '15b, describes his experience in rearing the species from skin scraped from the back of a Negro who was suffering from a skin disease known as caraate. This author has no proof that it is the causal organism or even a normal secondary parasite. Mr. Brues cites Heuser, '10, who bred the species from larvæ which had been removed from an Indian's foot.

Perhaps an added proof of the synonymity of *Aphiochaeta scalaris* and *A. ferruginea* is the fact that Brues, '15b, under his description of *A. ferruginea*, refers to a figure in the report proper (Brues, '15a) and that this figure is labelled *A. scalaris!*

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[1] Contributions from the Entomological Laboratories of the University of Illinois, No. 61.

From the above citations it will be seen that the species has a very wide distribution and a remarkable diversity of larval habitat. The presence of this insect in milk suggests a possible method of its reaching the human intestine. Its occurrence in this country offers another reason, if such be needed, for safeguarding our milk supply.

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THE OCCURRENCE OF THE CHINCH-BUG (BLISSUS LEUCOPTEROUS) IN EASTERN MASSACHUSETTS

By Geo. W. Barber, *U. S. Bureau of Entomology*

The Chinch-bug is so little thought of as a serious pest in New England that an account of its destructive occurrence in that section may not be without interest.

On August 12, 1919, the writer's attention was first directed to the occurrence of this insect in Massachusetts. A visit was made to the Frick estate in Beverly, where the insect had first been discovered.

The Frick estate adjoins the sea and contains small natural wooded areas, dense groupings of shrubs and flowers, and lawns extending over a considerable area. It was found that the beautiful lawn of the estate had been entirely destroyed over an extent of several acres by the insect which was then present in great numbers as adults and nymphs of all stages. The lawn had been composed principally of blue grass, and this appeared to be the principal food of the insect, clover, weeds, and the coarser grasses being for the greater part untouched and the only green vegetation remaining.

Adults were already seeking winter quarters and were found in the collected leaves protecting the roots of shrubbery, and in the leaf mold in the wooded areas. The insect was generally very numerous throughout the estate even on buildings and fences, in some corners of the latter being upwards of an inch deep. A few were found in adjoining estates but the infestation seemed to be almost wholly confined to the Frick estate. A less serious infestation was found on the Tucker estate in Manchester, some two miles distant. Here the insect had destroyed small areas of the lawn which appeared as brown spots a few feet in diameter. The insect was not found between these two estates.

It has been suggested that sheep manure procured from an unknown

source in the West and which was used extensively on the lawns of these estates may have been the means of introducing the insect.

It is more probable, however, that the destructive infestation was due to the insect hibernating in large numbers during the winter of 1918–19 which was very mild in this section, whereas in the normal more severe winter very few survive.

On January 7, 1920, the lawn of the Frick estate had been burned and plowed and put in condition for spring planting, all leaves and débris about shrubs and in the wooded areas had been collected and burned and replaced by uninfested material. The adults were, however, hibernating in considerable numbers in the roots of certain clump grasses, but it is doubtful if these will give sufficient protection for the insect to survive in numbers great enough to become injurious next season.

Scientific Notes

Hessian Fly and History. The Billop house at Tottenville, Staten Island, one time the headquarters of General Howe, who gained an undesirable notoriety as commander of the Hessians, is being fitted up with machinery for the manufacture of insecticides, we are informed by Mr. M. T. Smulyan. The Hessians are supposed to have been the unintentional introducers of the Hessian fly and it is certainly a most interesting coincidence that the headquarters of their commander should at this late date be transformed into an insecticide plant.

New Gipsy Moth Colonies. Two new gipsy moth colonies outside the known infested area, were reported during the month of July, one at Somerville, N. J., by Mr. Harry B. Weiss, State Inspector, and the other at Brooklyn, N. Y., by Mr. George G. Atwood, of the Department of Farms and Markets, Albany, N. Y.

The caterpillars were nearly full grown at the time the reports were received by the Bureau of Entomology, but scouts have been detailed to examine the territory to determine the extent of the infestation, after which control measures will be put in force. A. F. B.

A European Pest Found in Massachusetts. The Satin Moth (*Stilpnotia salicis* Linn.), has recently been found in Medford, Mass. This insect is closely related to the gipsy moth and the brown-tail moth. The larvæ feed on poplar, willow and other trees. In the area where the worst infestation was found, some poplar trees were defoliated and others were partially stripped. The insect was not discovered until the larvæ were nearly full grown, and it was too late to spray effectively. Large numbers of the caterpillars and pupæ have been crushed and egg clusters treated with creosote, so that the infestation at this point has been materially reduced.

The work has been carried on in the area controlled by the Metropolitan Park under the direction of Mr. A. N. Habberley, Superintendent of the Middlesex Fells Reservation, and adjoining property has been treated by agents of the Massachusetts State Forester. Assistants of the Bureau of Entomology have conducted scouting work in the vicinity and in the adjoining towns, and at present infestations have been found in twenty-seven towns. Observations on the life-history, habits, and information concerning control, is being secured by assistants at the Gipsy Moth Laboratory, Melrose Highlands, Mass. A. F. B.

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

JUNE, 1920

The editors will thankfully receive news items and other matter likely to be of interest to subscribers. Papers will be published, so far as possible, in the order of reception. All extended contributions, at least, should be in the hands of the editor the first of the month preceding publication. Contributors are requested to supply electrotypes for the larger illustrations so far as possible. Photo-engravings may be obtained by authors at cost. The receipt of all papers will be acknowledged.—Eds.

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A bulletin just issued by the National Research Council lists more than three hundred laboratories maintained by industrial concerns in America, in which fundamental scientific research is carried on. The bulletin gives a brief account of the personnel, special equipment and particular kind of research carried on in each of the laboratories listed. Industrial research laboratories have increased notably in number and activity, both in America and Great Britain, since the beginning of the War, because of the lesson vividly taught by the war emergency. It was only by a swift development of scientific processes that the Allies and America were able to put themselves in a position first to withstand and then to win a victory over Germany's science—backed by armies and submarines. And it is only by a similar and further development that America and the Allies can win over Germany in the economic war-after-the-war, now being silently but vigorously waged.

The above applies to all sciences and in this advance entomology must take its place. The preliminary steps recently taken in relation to a Plant Protection Institute promises much in the way of more fruitful investigation and more effective coöperation not only among entomologists but between them and those engaged in related sciences. There is greater need than ever for the highest type of coördinated investigation and demonstration if we are to meet in full obligations laid upon us by present day conditions.

Obituary

WILBUR ROSS McCONNELL

The death of Professor W. R. McConnell, which occurred on June 23 last, at Carlisle, Pennsylvania, deprived the Federal Bureau of En-

tomology of the services of one of its most brilliant, able, and amiable young entomologists.

Wilbur Ross McConnell was born at Whitesburg, Pa., in 1881. The basis of his education was secured in the public schools at that place. He graduated from the Pennsylvania State Normal School at Indiana, in 1900, and from the Pennsylvania State College in 1906, with the degree of B. S. specializing in zoölogy and entomology. Professor McConnell took a special course in zoölogy at Cornell University in 1908, and received his M. S. from Pennsylvania State College in 1910.

After matriculation Professor McConnell served as Scientific Assistant in the Division of Zoölogy of the Pennsylvania State Department of Agriculture at Harrisburg, Pennsylvania, where he conducted researches regarding the animal foods of native reptiles, and especially the snakes and turtles of Pennsylvania. The results of these studies have been published in the bulletin of the State Division of Zoölogy. In the fall of 1907 Professor McConnell was appointed Assistant Professor of Zoölogy and Entomology at the Pennsylvania State College, and placed in charge of the Department. His work in this capacity was very successful, as shown by the character of his graduates, a considerable number of whom are among the most successful investigators in Federal and State employ.

In 1912 Professor McConnell was appointed Scientific Assistant in the Federal Bureau of Entomology, and assigned by the late Professor Webster to the study of the fall army worm in the lower Mississippi Valley. Shortly afterward he was placed in charge of an entomological field station at Greenwood, Mississippi, where he remained for about one year. While there he conducted with marked ability investigations of the parasitic enemies of the fall army worm and insects attacking the leguminous forage crops. Professor McConnell's work at Greenwood was terminated prematurely by an attack of illness, from which he never fully recovered. The summer of 1914 was spent in the investigation of the insect enemies of forage crops in the southwestern states, and in the fall of that year he was placed in charge of a field laboratory at Hagerstown, Maryland, with the investigation of the Hessian fly as his major project. In this work he made especial progress in the study of the Hymenopterous parasites of the insect. These studies were transferred to Carlisle, in 1917, where he was deeply immersed in research when stricken by fatal illness.

Professor McConnell's additions to our knowledge of the insect parasites of the Hessian fly are numerous and valuable. Several species new to science were discovered by him and the list of parasites of the Hessian fly in America was enriched from some half dozen or more to at least thirty species. Professor McConnell had chosen as his special

field the determination of the effect of these parasites on the abundance and the periodical outbreaks of the host. With this idea in view he had made an exhaustive study of the factors bearing upon the rate of multiplication of the insect, a summary of which will soon appear in print.

Professor McConnell was the possessor of a broad, thorough training in zoölogy and general natural history, which permitted him to approach his problems in a big way. He was an indefatigable worker, and most deeply interested in his work. This led to the overdraft of his reserve powers, already reduced by previous illness, and there is no doubt in the minds of his associates that his life was sacrificed to entomological research.

Professor McConnell was a member of the Entomological Society of America, the American Association of Economic Entomology, the American Association for the Advancement of Science, and the Entomological Society of France. W. R. W.

Reviews

Orthoptera of Northeastern America with Especial Reference to the Faunas of Indiana and Florida. By W. S. Blatchley. The Nature Publishing Company, Indianapolis, 784 pages, 246 text figures and 7 plates, with bibliography, glossary and index, 1920.

As stated by the author, this book has been prepared to supply the long-felt need of a single comprehensive manual on the Orthoptera inhabiting the United States east of the Mississippi River and Canada east of the 90th Meridian. Hitherto the student working in this group has been compelled to resort to a large number of special publications—many of them out of print or difficult to obtain—in order to get the descriptions to enable him to determine the species he may have collected or the information he may have desired regarding their habits or distribution. During the last two decades, as a result of the extensive investigations of Rehn and Hebard, Caudell, Morse, Davis and other workers, most of the problems connected with the nomenclature of the group have been cleared up and the limits of the different species, with few exceptions, clearly defined. There seems to be every reason to believe that the vast majority, if not all, of the Orthoptera of the Eastern States are now known, and one can therefore heartily agree with the author when he states that he deems the time propitious for the appearance of a work of this kind.

The present work is an outgrowth or expansion of the authors' earlier work, "Orthoptera of Indiana," issued in 1903. In the preparation of the book the author states that he has "ever had in mind the needs of the tyro and not those of the specialist in Orthoptera, the primary object in view being a simple work which would enable beginners in the most direct way possible to determine the scientific names and arrange and classify the Orthoptera in their collections." For this reason keys "based on the more salient or easily recognizable characters separating the divisions to which they pertain" have been made an important feature of the book. In the judgment of the reviewer the book is admirably adapted for this pupose. It puts for the first time at the disposal of those who are not specialists in Orthopteran taxonomy the means for ascertaining the species of Orthoptera with which they may happen to be

concerned, as well as supplying additional information which could otherwise be obtained only after much sacrifice of time and effort. To the amateur, the entomological beginner, the field naturalist, the economic entomologist, the cytologist, and others who may be dealing with Orthopteran material, but are not specialists in the group, a work such as the present one ought to be of the greatest service. The reviewer vividly recalls the help and inspiration which in his earlier studies of Orthoptera he derived from the use of Professor Blatchley's Orthoptera of Indiana, which in spite of its limited applicability was the only work of a comprehensive nature obtainable at the time. The present work with its inclusion of the entire eastern fauna and its "up-to-dateness" is naturally vastly superior to the earlier work on the Indiana fauna, and the reviewer therefore feels himself justified in predicting for it an increasing popularity and a wide field of usefulness in arousing interest in Orthoptera or in subjects connected with them.

There is one error in the book to which the reviewer desires to call attention, as it is possible that he may be partly responsible for it. On page 558 the record credited to the reviewer from Morristown, N. J., should be Moorestown, N. J. This error may have been typographical, or it may have been due to a misreading of the reviewer's label attached to the specimen sent to Professor Blatchley.

HENRY FOX

Current Notes

Conducted by the Associate Editor

Dr. E. D. Ball, state entomologist of Iowa, was appointed June 12 by President Wilson as Assistant Secretary of Agriculture.

Major General William C. Gorgas, who was appointed a member of a commission sent to West Africa to investigate sanitary conditions, suffered a stroke of apoplexy in London, May 31 and died July 3.

At the North Carolina State College, Mr. Herbert Spencer has been promoted from instructor to assistant professor of Zoölogy and Entomology and Mr. J. H. Williams from assistant to instructor in Zoölogy and Entomology.

Professor Z. P. Metcalf, professor of Zoölogy and Entomology, North Carolina State College, and Entomologist, North Carolina Experiment Station, was elected President of the North Carolina Academy of Science at the last annual meeting.

Professor Herbert Osborn of the Ohio State University will spend two months at the Forest Camp of the New York State Forestry School, located at Cranberry Lake in the Adirondack forest, investigating forest insects, expecially Hemiptera of the region.

The honorary degree of Doctor of Science was conferred upon Wilmon Newell, president of the American Association of Economic Entomologists, and Plant Commissioner of Florida, by Iowa State College at its semi-centennial celebration in connection with commencement in June.

Early in May W. H. Lyne, provincial inspector at Vancouver, B. C. found some suspicious looking larvae in the soil surrounding the roots of maple and Thuya seedlings from Japan. The larvae were forwarded to Mr. J. J. Davis in charge of the Japanese Beetle Investigations in New Jersey, for identification. Mr. Davis reported them as not being the larvae of the Japanese beetle but a closely allied species.

Dr. L. O. Howard attended the Imperial Entomological Conference held in London, early in June. *Nature* states that "much gratification was felt and expressed at the presence for the first two days of Dr. L. O. Howard, entomologist of the U. S. Department of Agriculture. His brief pointed remarks at some of the discussions were much appreciated; he deplored some recent attempts to destroy "entomology" as a specific

economic subject by dividing its subject matter between "parasitology" and "phytopathology."

According to *Entomological News*, Mr. Harry B. Weiss, on May 1, was appointed chief of the Bureau of Statistics and Inspection, New Jersey Department of Agriculture, to fill the vacancy caused by the death of Franklin Dye.

Mr. Irving W. Davis, Connecticut Agricultural Experiment Station, who for nearly seven years has served as assistant entomologist and deputy in charge of gipsy and brown-tail moth work in Connecticut, resigned June 8, to enter the banking business. He will remain in Danielson, Conn., where he has had headquarters for four years.

According to *Science*, Mr. E. P. Van Duzee, curator of Entomology, in the California Academy of Sciences and Dr. E. C. Van Dyke, of the University of California, who attended the annual meeting of the Pacific Division of the American Association for the Advancement of Science in Seattle, will remain for a month in the state of Washington for field work. Mr. Van Duzee, who specializes in the Hemiptera, has in his collection and that of the California Academy of Sciences, probably the most representative collection of Hemiptera in America. Dr. Van Dyke will collect Coleoptera in which he is a specialist.

The following appointments have been made to the staff of the Entomological Branch, Canadian Department of Agriculture: Mr. H. W. Crosbie, temporary seasonal assistant, Division of Forest Insects from May 15; Mr. J. D. MacFarlane, temporary seasonal assistant, Division of Forest Insects, from May 25; Professor A. V. S. Pulling, seasonal entomologist, Natural Control Investigations from May 15; Mr. G. M. McFarlane, temporary Junior Entomologist at Saskatoon, Sask., from May 1; Mr. H. A. Robertson, temporary Junior Entomologist at Treesbank, Man., from May 15; Miss A. C. Healey, temporary clerk-stenographer at Vernon, B. C., from May 15. Messrs. Crosbie, MacFarlane and Pulling will be engaged on the spruce budworm investigations with headquarters at Fredericton, N. B.

According to *Science*, the official delegates to the Imperial Entomological Conference which opened in London, June 1, were as follows:—Canada and South Africa, Mr. C. P. Lounsbury; Australia, Professor R. D. Watt; New Zealand, Dr. R. J. Tillyard; India, Mr. C. F. C. Beeson; Queensland, Mr. F. Balfour Browne; British Guiana, Mr. G. E. Bodkin; Ceylon, Mr. F. A. Stockdale; East Africa Protectorate, Mr. T. J. Anderson; Federated Malay States and Straits Settlements, Mr. P. B. Richards; Gold Coast, Mr. W. H. Patterson; Imperial Department of Agriculture for the West Indies and Leeward Islands, Mr. H. A. Ballou; Mauritius, Mr. G. A. Auchinleck; Northern Rhodesia, Mr. R. W. Jack; Seychelles, Dr. J. B. Addison; Sierra Leone, Mr. H. Waterland; Sudan, Mr. H. H. King; Trinidad, Mr. F. W. Urich, and Uganda, Mr. C. C. Gowdey.

With the advice and assistance of the National Research Council, a coöperative body of scientific experts on injurious insects and plant diseases and of manufacturers of insecticides, fungicides and general chemicals and apparatus used in fighting the enemies of field and orchard crops, has just been organized under the name of the Plant Protection Institute. The purpose of the institute is to promote the general welfare by supporting and directing scientific research on the pests of crops, shade trees and ornamental plants, and on the methods of their control, and by furthering coöperation between the scientific investigators and the manufacturers of chemicals and appliances, especially for the sake of effecting standardization and economy in the production and use of the means of fighting pests. Also it expects to aid in the dissemination of scientifically correct information regarding the control of injurious insects and plant diseases. Much excellent work along this line is now being done by government and state organizations, but a further advance can be made by introduc-

ing a wider coördination and coöperation of the efforts of both the scientific men and the manufacturers of control devices. It is in this general direction of coöperative work that the Plant Protection Institute expects to be most active.

The Department of Zoölogy and Entomology, North Carolina State College is making an addition to its present building. The addition consists of two parts, a service building and an insectary. The service building will contain an underground pit for the study of subterranean insects, a potting room, a small apiculture laboratory and a laboratory for advanced students in entomology. The insectary is of modified greenhouse construction with solid roof to obstruct the direct rays of the sun. It is divided into three sections, two of which are enclosed by glass and heated, and one enclosed by screening and not heated.

Five field parties have been organized for the spruce budworm investigations in New Brunswick; these will be in charge of Messrs. Gorham, Kinghorn, Pulling, Simpson and Dunn. Professor Pulling is professor of Forestry at the University of New Brunswick and Mr. Kinghorn has been transferred to this survey by the Provincial Crown Lands Department. Four parties will proceed to Nictau Lake where a headquarters camp will be erected. The fifth party will use Juniper as their headquarters. Mr. Dustan has started a series of experiments on the natural control of the green apple bug at Wolfville, N. S.

On May 24 an amendment to the regulations under the Canadian Destructive Insect and Pest Act was passed by Order in Council prohibiting the importation of corn and broom corn, celery, green beans, beets, spinach, rhubarb, oat and rye straw, cut flowers of chrysanthemums, asters, cosmos, zinnias, hollyhocks, gladiolus and dahlias from the towns infested with the European Corn Borer in the states of Massachusetts, New Hampshire, New York and Pennsylvania, unless the same are accompanied by a certificate of inspection issued by the Federal Horticultural Board. The amendment dealing with this pest and passed May 19, 1919, is rescinded.

Professor W. B. Herms of the University of California has established a temporary summer laboratory in the Sacramento Valley near Vina, Tehama County, Cal., for the purpose of investigating certain malaria-mosquito problems in that vicinity, notably factors governing breeding habits of anophelines, their egg laying habits and per cent of infection. Three species of anophelines are present; namely, *A. occidentalis* (western variety of *A. quadrimaculatus*) *A. punctipennis* and *A. pseudopunctipennis* together with a prevalence of malaria. Collaborating with Professor Herms is Professor S. B. Freeborn, also of the University of California and a small group of students. The present intensive investigation follows a general malaria-mosquito survey of California which was completed last summer.

The National Research Council, a coöperative organization of leading scientific and technical men of the country for the promotion of scientific research and the application and dissemination of scientific knowledge for the benefit of the national welfare, has elected the following officers for the year beginning July 1, 1920:—Chairman, H. A. Bumstead, professor of Physics and Director of the Sloane Physical Laboratory, Yale University; First Vice-Chairman, C. D. Walcott, president of the National Academy of Sciences and Secretary of the Smithsonian Institution; Second Vice-Chairman, Gano Dunn, president of the J. G. White Engineering Corporation, New York; Third Vice-Chairman, R. A. Millikan, professor of Physics, University of Chicago; Permanent Secretary, Vernon Kellogg, professor of Biology, Stanford University; Treasurer, F. L. Ransome, treasurer of the National Academy of Sciences. The Council was organized in 1916 under the auspices of the National Academy of Sciences to mobilize the scientific resources of America for work on war problems, and reorganized in 1918 by an executive order of the president on a

permanent peace-time basis. Although coöperating with various government scientific bureaus it is not controlled or supported by the government. It has recently received an endowment of $5,000,000 from the Carnegie Corporation, part of which is to be expended for the erection of a suitable building in Washington for the joint use of the Council and the National Academy of Sciences. Other gifts have been made to it for the carrying out of specific scientific researches under its direction.

According to *Science*, Dr. Frank E. Lutz of the American Museum of Natural History, of New York City, has started on the third of a series of expeditions planned to trace the distribution of insect life in the western part of the United States. The first of these expeditions collected in the Santa Catalina Mountains and the deserts of southern Arizona; the second—made last year,—worked in the Colorado Rockies. This year special attention will be paid to regions north and west of Colorado.

INFORMAL CONFERENCE AND FIELD MEETING OF EASTERN ENTOMOLOGISTS

The meeting called to order 10.30 a. m., July 29, 1920, at Philadelphia in the rooms of the Academy of Natural Sciences of Philadelphia. A. F. Burgess was elected chairman and J. J. Davis secretary of the meeting.

The chairman appointed the following committees:

Nominating Committee: Robert Matheson, A. L. Quaintance and J. L. King.

Resolutions Committee: E. P. Felt, J. G. Sanders and H. B. Weiss.

The forthcoming Bibliography of Economic Entomology was discussed by Messrs. Burgess and Felt. Members were urged to immediately subscribe for this Bibliography and to secure as many additional subscriptions as possible to ensure sufficient support for the publication.

The remainder of the morning session was taken up in a discussion of the present fruit insect situation which was led by A. L. Quaintance.

In the afternoon the members visited the Japanese beetle laboratory at Riverton, N. J., where they had an opportunity to note the investigations being conducted and the damage caused by the beetle.

An informal meeting at the Vendiz Hotel, Philadelphia, was occupied by a full discussion of the Japanese beetle problem. The work was explained by Messrs. Quaintance, Davis, Stockwell and Hadley and discussed by a number present.

The session was resumed at 9.30 a. m., July 30, in the rooms at the Academy of Natural Sciences.

The work and present status of the European corn borer was fully explained by Messrs. Worthley, Felt, and Caffrey and discussed by a number present.

The discovery in Massachusetts of a new European caterpillar pest of poplar and willow, commonly known as the Satin moth, was reported by A. F. Burgess.

Messrs. Burgess and McIntyre also explained the Gipsy moth situation, particularly the new discoveries of the pest in New Jersey and New York.

The nominating committee made the following recommendations: Chairman, Dr. W. E. Britton; Secretary, Dr. T. J. Headlee.

The recommendations were adopted.

The committee on resolutions submitted the following:

Whereas, We, a group of Entomologists of the North Eastern United States, assembled at Philadelphia, Pa., in an informal conference and field meeting, hereby record our conviction that the presence of certain introduced insects in various parts of the country constitutes a serious menace to our material welfare, Therefore be it

Resolved.—That the control work against the Japanese beetle is hereby heartily approved and that those in charge be urged to enlarge and extend the work already

under way in the development of a satisfactory insecticide and that no efforts be spared in pushing the search for natural enemies here and abroad.

Resolved.—That the establishment of the Gipsy moth over a considerable area remote from the previously known infested territory is most unfortunate and that the situation demands adequate appropriations by Congress for the speedy extermination of the pest in these newly infested areas and for a continuance of the effective repressive measures in New England.

Resolved.—That the European corn borer must be regarded as potentially a very dangerous insect and in view of its wide distribution, prevention of further spread and large scale determination of effective control methods are especially important, and because the situation is so complex there is special need of the closest coöperation between federal and state authorities.

Resolved.—That in view of the presumable importance of natural enemies in the control of certain of these pests and the very great differences in habits and requirements of these beneficial insects, we earnestly recommend that the work of importation be enlarged and the sending to foreign countries of several specialists in their respective lines.

And be it further *Resolved.*—That this informal branch meeting has been most encouraging and profitable and we therefore recommend the establishment of an Eastern Branch of the American Association of Economic Entomologists.

Resolved.—That we express our thanks to President Wilmon Newell for his encouraging and decisive letter addressed to this meeting in consequence of his enforced absence from the sessions.

Resolved.—That our most sincere thanks be extended to The Academy of Natural Sciences for the courtesies extended and to Mr. J. J. Davis for making such excellent provision for the meetings both in Philadelphia and at Riverton. Furthermore, we would recognize the generous assistance of citizens of Riverton.

E. P. Felt
J. G. Sanders
H. B. Weiss

The above resolutions were unanimously adopted.

The following is a list of those present: E. D. Ball, Washington, D. C.; P. T. Barnes, Harrisburg, Pa.; Theo. L. Bissell, Torresdale, Pa.; A. F. Burgess, Melrose Highlands, Mass.; D. J. Caffrey, Arlington, Mass.; E. L. Chambers, Washington, D. C.; A. B. Champlain, Harrisburg, Pa.; C. W. Collins, Melrose Highlands, Mass.; E. N. Cory, College Park, Md.; E. M. Craighead, Harrisburg, Pa.; E. T. Cresson, Jr., Philadelphia, Pa.; S. S. Crossman, Melrose Highlands, Mass.; J. J. Davis, Riverton, N. J.; D. M. DeLong, Harrisburg, Pa.; E. P. Felt, Albany, N. Y.; D. E. Fink, Riverton, N. J.; F. W. Foster; Henry Fox, Riverton, N. J.; S. W. Frost, Arendtsville, Pa.; T. L. Guyton, Harrisburg, Pa.; C H. Hadley, Riverton, N. J.; E. A. Hartley, Oak Lane, Pa.; T. J. Headlee, New Brunswick, N. J.; P. H. Herzog, Hightstown, N. J.; V. G. Hipple, Riverton, N. J.; H. E. Hodgkiss, State College, Pa.; W. O. Hollister, Kent, O.; J. L. Horsfall, Bustleton, Pa.; J. L. King, Harrisburg, Pa.; H. B. Kirk, Harrisburg, Pa.; J. N. Knull, Hummelstown, Pa.; M. D. Leonard, Ithaca, N. Y.; Robert Matheson, Ithaca, N. Y.; H. L. McIntyre, Melrose Highlands, Mass.; Alvah Peterson, New Brunswick, N. J.; J. K. Primm, Oak Lane, Pa.; A. L. Quaintance, Washington, D. C.; J. G. Sanders, Harrisburg, Pa.; J. D. Sherman, Mt. Vernon, N. Y.; J. R. Stear, Chambersburg, Pa.; C. W. Stockwell, Riverton, N. J.; F. M. Trimble, West Chester, Pa.; R. T. Webber, Melrose Highlands, Mass.; C. A. Weigel, Washington, D. C.; H. B. Weiss, New Brunswick, N. J.; F. H. Worsinger, Jr., Torresdale, Pa.; and L. H. Worthley, Boston, Mass.

Mailed August 16, 1920.